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Ellipsis...

An Editorial By Vern Riportella, WA2LQQ*

Competition for scarce resources has apparently always played a key role in society. The need to secure reliable supplies of tea, nitrates and spices, for example, has driven some men to set sail and others to die on the slopes of the Himalayas. Darwin saw a broader picture. He believed competition to be central to natural selection; virtually evolution's dynamo.

In the amateur radio domain the scarce resource is spectrum. More precisely, the crowding of the available hf and lower vhf spectrum is seriously out of control. This is not news to many. One has merely to witness the cacaphony of 20-meter ssb on a Sunday afternnon to learn all one needs to know about stress in crowds and survival tactics in fierce competition.

What may come as a surprise, however, is the realization that in many regions the vhf spectrum is nearly as saturated. It is against this backdrop that planners of the next generation of amateur radio satellites seek solutions to a classic dilemma.

The dilemma is straightforward; a collision between an immovable object and an irresistible force.

On the one hand we have the immovable object. The present OSCAR user has a sizeable investment in "plant" and "equipment." He is keenly interested in preserving as much of his investment as possible. He thus values highly the continued use of frequencies and modes compatible with his existing equipment suite. Occasionally, the individual's continued access to OSCAR hinges on the preservation of Mode A. For one reason or another he may be unable to acquire Mode B or J capability. To him, higher frequency may mean higher cost and it may mean he is shut out of the newer modes. The hoopla surrounding the new uhf transponders only tends to exacerbate his frustration at being locked into Mode A; an apparently endangered species of bird! Planners explicitly recognize this factor and euphemistically refer to it as the "backward compatibility" factor. They realize that to be acceptable, a new spacecraft should possess a viable component of backward compatibility. Otherwise the instant obsolesence resulting by omitting it would create broad pockets of resentment in the user community.

On the other hand witness the irresistible force. It is the force of progress that says, in effect, "Evolve or perish!" The evoluntionary imperative is here professed by an equally adamant community who argues well that we need to keep moving upward in frequency lest the pack of stalking hyenas overcome us all. In somewhat less guarded moments these progressives confess a more subjective bent for the need to be constantly scouting new turf. Their main joy is not in operating satellites but rather in their creation. Once a spacecraft is flown, it's on to the next plateau. Society at large never really catches up with these fellows.

The planners' dilemma is merely (!?!) to maintain a balance such that all the correct things get done; the entire community functions. That is, the user community should not feel prematurely stampeded to new forage. The progressives must be lightly tethered in their flights of fancy lest they lose sight of the folks who pay the bills; the users. Balance is essential.

How well have the planners responded to the challenge? Have they kept the herd moving yet moderated the sprints of the gazelles up front? It seems an apt question at this juncture now that we are poised for the Phase IIIB launch with its new transponders on 1269 and 436 MHz.

Recall that when AMSAT-OSCAR 7 went aloft there were occasional whimpers from those who could not work Mode B. They wanted more Mode A time. Soon Mode B became the most popular mode ever; so popular that it was jammed most of the time. People adapted and joined the fun on B after a time. Then came AMSAT-OSCAR 8 with its "silly" Mode J. A lot of bellyaching and carping was heard until folks found out how much could really be done with this fine mode once they knew what to expect and how to get the most from it. Recently Mode J has shown signs of becoming the most popular mode yet since it yields many of the merits of B but without the crowding. Again many of the Mode A folks, when they managed the transistion, not only found something to like in the new mode, but became staunch defenders of their newly discovered turf.

Phase IIIB will be the first transponder-equipped OSCAR to fly which has not included a 10 meter downlink. Does this mean, as some suggest, that AMSAT will be severing the beginners' access route? Obviously the question presumes that 10-meter equipment is the key. We don't agree. Vhf and uhf equipment abounds in many nations today and is becoming available in the others. So although the question would have been answered quite differently a decade ago, today the beginners' access route might just as well be 2 meters or above. Furthermore, there is ample reason to conclude there are more Mode A birds in the RS roost to serve the firmly immobile Mode A community. This is

(Continued on page 17)

Editor-In-Chief, ORBIT *Magazine*

Utilization of the Phase IIIB Special Service Channels

By Rich Zwirko,* K1HTV and Bob Ruedisueli, W4OWA**

The SSC concept is explained and you're invited to help define future uses for these new resources.

Here is an opportunity to contribute your experience to the Phase IIIB planning process. Your comments concerning the material presented here will assist AMSAT planners with the task of providing a spacecraft optimized to serve the best interests of the world community of radio amateurs.

You may recall that the Phase IIIA transponder passband was wide enough to support three 4 kHz wide channels at each edge in addition to the 124 kHz passband available for general use. (See Phase IIIA Bandplan, *ORBIT* #1, March 1980.) These channels were designated as Special Service Channels (SSCs L1, L2, L3 & H1, H2, H3). Phase IIIA planning included rather rigid specifications for the utilization of these six SSCs. Since then, further discussions and incoming comments conerning the Phase IIIA SSCs from future users has prompted rethinking the use of the comparable portions of the Phase IIIB transponder passband.

Objections to Phase IIIA SSC Plan

Concern was expressed that some of the six SSCs would lie idle a good portion of the time, thus wasting much of the otherwise usable passband. Some AMSAT members felt that the SSCs were not needed at all! Others felt that the "controls" placed upon the use of the SSCs were too structured and perhaps seemed to be a bit dictatorial. International users felt that the SSC plan favored U.S. hams and were of little value to interests elsewhere. Some users took exception to placing so much emphasis on the value of the SSCs to schools, colleges, etc. Still others agreed that some control over the SSCs was necessary.

Apart from the obvious educational and operational value, one of the key arguments for the SSCs orginally concerned the fact that users tend to stay away from the transponder's band edges so, why not put this unused spectra to good use? The SSCs seemed a viable answer to this question.

It would appear that the original Phase III SSC concept left much to be desired in the eyes of many. Phase IIIB presents us with a new opportunity to better plan Special Service Channel utilization.

Proposed Phase IIIB SSC Utilization

These are our proposed views as they exist currently. They are not final. There is still time to make changes. Further discussion and comments are needed to assure an equitable plan. Flexibility is uppermost in our minds during this planning phase. The SSCs must be arranged so as to allow maximum utilization of the available bandpass while providing as many options as possible.

As in Phase IIIA, the Special Service Channels will be placed at each passband edge. At least initially, however, only four channels are being considered: two at the high end and two at the low end. Unlike the SSCs for Phase IIIA the proposed IIIB SSCs would each be 5 kHz wide. In fact, if the need should arise, the two upper channels (H1 and H2) could be combined to provide a single 10 kHz wide channel. Likewise, the two lower channels could be combined to provide a single wide band channel that would support high speed data transmission.

The upper channels (H1, H2) would be utilized for voice transmission while the lower channels (L1, L2)

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would be utilized strictly for cw and data. This is in keeping with the conventionally practiced passband plan that provides the lower ⅓ portion for cw, the upper ⅓ for ssb and the middle ⅓ for mixed cw/ssb. These relationships are pictured in Fig. 1.

Proposed Voice SSCs

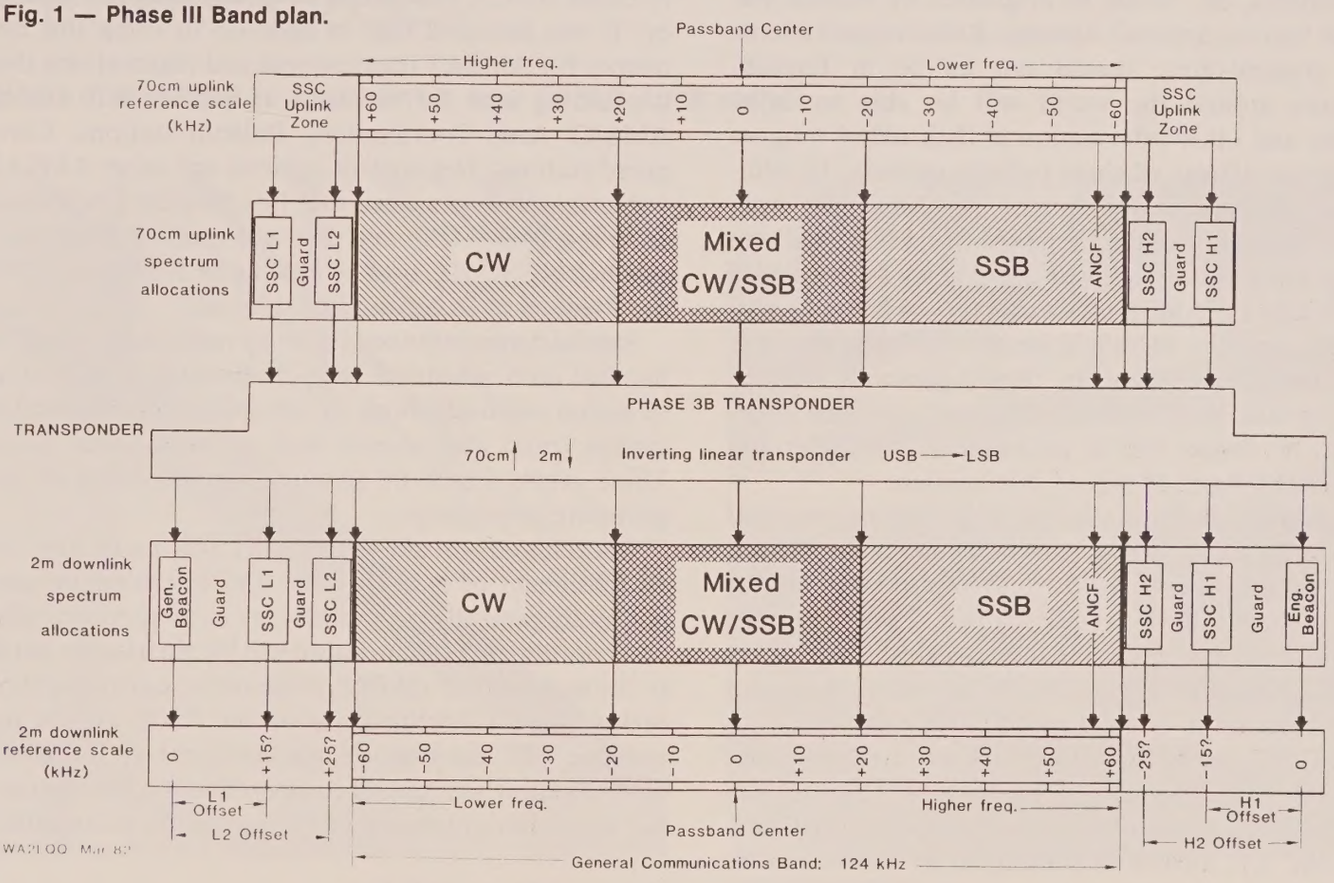
For the sake of argument let us refer to the upper two SSCs as "H1" and "H2." H1, occupying the higher frequency, would be used primarily for one way broadcast bulletins such as may be originated by any of the IARU Societies; ARRL, RSGB, etc. H1 would also be used at times, for certain educational and scientific programs. More on this later. H2 would be used primarily in connection with scientific programs, and to a lesser extent, as backup for bulletins and education programs. H2 would also be used for certain two-way network activity such as coordinating or relaying information about propagation studies, solar events, moon-bounce and meteor scatter transmissions or in support of various world wide AMSAT activities. The need for maximum flexibility however, may necessitate using "Voice 1" for those programs intended primarily for H2 and vice-versa as situations may dictate.

Proposed CW and/or Data SSCs

Consider the two lower SSCs, (L1,L2) as consisting of two 5 kHz wide segements, the band widths of which could be varied to accommodate a variety of data transmissions. The lower (L1) frequency segment (one closest to the lower edge of the pass band) for instance, could be used for ASCII packet transmission while the upper (L2) segment could be made available for cw and/or RTTY work.

Since each of these 5 kHz segments can accommodate several individual slow speed channels some thought must be given to how the segments could be compartmentalized. The L1 segment would be used primarily for experimental data services such as those being pursued by AMICON. Hank Magnuski, KA6M, functions as focal point for these activities. Several AMICON groups, those in San Francisco, Washington, D.C., New Jersey, Ottawa, Vancouver and in Sweden, for instance, could be linked together by a packet network

Fig. 1 — Phase III Band plan.



Notes:
1. ANCF: AMSAT Net and Calling Frequency.
2. Beacons tentatively placed at 145.812 MHz (General) and 145.990 MHz (Engineering).
3. Passband centers (uplink and downlink) will be announced after systems calibration. Approximate values are: 435.100 MHz uplink and 145.900 MHz downlink.
4. All frequencies and allocations subject to final approval.

utilizing the L1 segment. L1 may also be used on occasion for science programs.

L2, the upper 5 kHz segment, would be used primarily for cw and RTTY bulletin transmissions and for scientific programs and experiments utilizing cw or RTTY. This SSC could also be used to support certain cw and traffic networks. The purpose of these nets would be to handle long haul transcontinental or even intercontinental third party traffic where permitted. A good example would be a regularly scheduled network for radio Amateurs interested in setting up EME (moonbounce), meteor scatter or trans-equatorial schedules.

Again, flexibility is the prime concern. Also, the two 5 kHz segments could be combined on occasions for special high speed data dumps, experiments or demonstrations.

Some Thoughts Concerning Users and Coordination

Although some control over the use of the Special Service Channels will obviously be necessary, it is intended that as much flexibility as possible be built into users' access plans.

Who are the users? Frequent transmissions of bulletins, propagation information, solar events announcements, etc. would be originated by bulletin stations of various national Amateur Radio organizations. Voice transmissions should not all be in English. Amateurs around the world will be able to enjoy bulletins and other information in their native tongues through the efforts of these bulletin stations. In addition to information of interest to Amateurs from various national societies there will be AMSAT bulletin stations transmitting the latest orbital data for the Phase IIIB, UoSAT, AMSAT-OSCAR 8, and Soviet RS satellites. Satellite users will be able to know the very latest operational plans for these spacecraft without having to wait long periods of time for published information. No longer will hf propagation anomalies and QRM be the cause of missed information.

Educational bulletin stations will transmit material primarily intended for a student audience in various school systems around the world where such Educational programs have been developed. The Phase IIIB satellite could link classrooms thousands of miles apart through Amateur Radio, exposing many potential future scientists to satellite communications.

AMICON, the AMSAT International Computer Network, will be another user of the Phase IIIB Special Service Channels. Some of the possibilities of AMICON, using SSC L1, include establishment of two-way computer links, computer networks, packet radio gateways for long haul traffic and even digitalized voice and video.

Individuals and groups of Radio Amateurs interested in serious scientific research could use Phase IIIB to perform meaningful experiments coordinated through Scientific Program Managers in the various countries around the world. How this coordination could be accomplished will be discussed in a future article which addresses this topic.

Certain regularly scheduled long haul third party traffic networks (cw and RTTY) would utilize Phase IIIB to provide a reliable channel for message handling, especially in times of emergencies. Individuals living in areas around the world where natural disasters have occurred could use the SSCs for relaying emergency messages in and out of the affected area. Amateur Radio could aid in getting disaster relief to areas where normal communications have been disrupted.

Other SSC users would include Net Control Stations and individuals participating in AMSAT nets, propagation nets, vhf/uhf experimentation nets and the like where input from the Amateur community is shared with others with the same common interest. A good example would be the reporting of major auroral, E_s, tropo, transequatorial or meteor scatter openings which require real time notification to those interested in participating.

One question arises from the above paragraphs. Should there be a specific listening or calling frequency where all could monitor when not communicating? In the Phase IIIA band plan there was proposed a frequency called ANCF, the AMSAT Net and Calling Frequency. It was intended that in addition to using this frequency for AMSAT international and regional nets that it could be used for exchange of Satellite info among AMSAT Area Coordinators, Bulletin stations, Command stations, Net control stations and other AMSAT volunteers. It is proposed that this frequency be included in the Phase IIIB band plan and that this frequency, just below SSC H2, also be used as an Emergency Calling Frequency, to be monitored by all.

Special demonstrations for or by radio clubs would be handled on a scheduled basis. Individual users wishing to put on demonstrations for schools or other interested groups could also reserve time on appropriate SSCs. These events would be arranged by contacting an appropriate coordinator.

Coordination of all this activity will necessitate the establishment of a world wide SSC coordination plan and an organization to administer it. A proposed plan and coordinating organization will be discussed in detail in the next issue of *ORBIT*. Meanwhile, one thought remains clear: disciplined use of the SSCs will be imperative. SSC use must be non-competitive! Therefore, co-ordination and mutual co-operation is a pre-requisite for which both planning and organization is essential.

Proposed Mode "L" Use

Since the Phase IIIB satellite will carry a 23 cm to 70 cm transponder, we should consider its utilization as well. We might try the following suggestion as a starting point.

The 800 kHz passband of the Mode L transponder

could be divided into two segments. A 200 kHz wide segment at the low end of the transponder pass band would look very much like the Mode B transponder, i.e., it would be divided into three segments: lower ⅓ cw, middle ⅓ cw/ssb and upper ⅓ ssb. Special Service Channels could be provided as in Mode B and would be utilized in much the same way.

The upper 600 kHz segment of the Mode L transponder would be reserved for wide band data transmission. The usage of this segment is really only limited primarily by the limitations of our imagination at this early point in time. But, here again, flexibility is our intent. The 200 kHz segment for general use could be changed if the situation warrants.

Mode L transponder use will grow quickly following some months of tests and experimentation. Growth will be stimulated primarily by two factors: the introduction of new equipment and possible crowding of the Mode B transponder. Mode L will then become a safety valve by absorbing more of the traffic. Then the proportion of time it's on can be expected to increase from the initially planned one day per week.

Conclusions

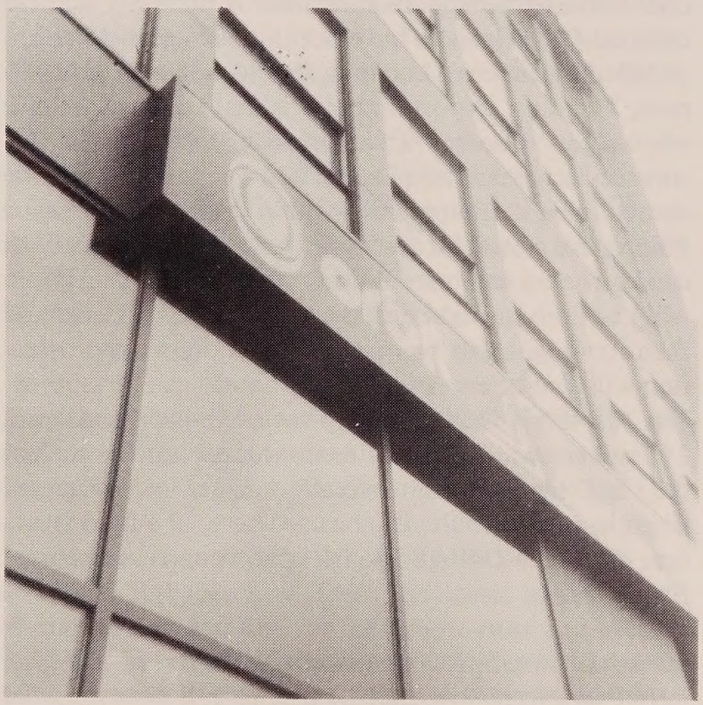
Your views, suggestions, recommendations, ideas, and criticisms will be considered for incorporation into the working plan. Our objective will remain to benefit the interests and aspirations of *all* our future Phase IIIB users.

Let us hear from you. Address comments to the Radio Amateur Satellite Corp., P.O. Box 27, Washington, DC 20044, Attention authors, K1HTV, W4OWA.

The authors would like to thank all those who contributed to this article, especially for comments from Pat Gowen, G3IOR; Haruo Yoneda, JA1ANG; Andras Gschwindt, HA5WH; Dom Mallozzi, N1DM and Steve Place, WB1EYI.

Comets

While the name is the same, the game sure isn't!



(VE2QO photos)

Montreal really has the satellite spirit. The Orbit sign is for a sports shop while the Oscar sign is for a candy store.

A Q&A About Helical Antennas

By Dick Jansson,* WD4FAB

Commonly asked questions about this favorite topic are answered by an AMSAT veteran. Many letters resulted from the WD4FAB article in* ORBIT 7. *Is your question here?

Question: *What size of copper tubing do you use for the element?*

Tubing for the 435-MHz antenna was ¼ inch copper which worked well. For the 146-MHz antenna a tubing size of ½ inch is recommended.

Question: *How is the tubing connected to the type N connector?*

My 435-MHz antenna used the element tubing sleeved over the connector pin and then bent shortly to the element. For matching reasons, it would be better to flatten the tubing and drill it for fitting over the connector pin, bringing the conductor into the connector nearly parallel to the reflector plane. More on this relating to matching.

Question: *What are the physical details of the hardline "reactance stub?" What feedpoint impedance can be achieved? Please expand upon this whole subject of helix antenna matching.*

Feedline matching: please *do not* use the W7US stub matching, it is very difficult to do in coaxial cable. While stub matching can be made to work (Ref: *ARRL Antenna Handbook*, 1974, Chapter 3) it won't in the manner that has been presented. Instead of stub matching I recommend the transformer method shown by K6ZMW in *QST* June 1981. I evolved the method shown in the *Mode J Newsletter*, August 1980. These two methods look different but are really the same and K6ZMW's is much neater. With either of these two methods the achievable match to 50-ohm (or even 75-ohm) feed lines will be flat and completely resistive.

Question: *What design parameters should be used for helicals?*

Helical antenna dimensions are shown in the attached chart drawn from a number of sources. As can be seen there is a great deal of similarity in the references as they are not independent. The principal point here is that a one-wavelength-per-turn conductor is the basis of these designs. Other lengths have been used to adjust the impedance parameter, but that should not be a concern here. The most important point is that the basic helix is a broadband device, with at least a 30% bandwidth. For construction materials, wood has worked well for me and it holds its shape well without a lot of "age sag." PVC is not noted for its "RF" properties but has been used on some antennas. I do not feel that a PVC boom will keep very straight unless a very large size is used and then its weight will be quite high and its wind crossection will also be excessive. Wood booms can be tapered. The WD4FAB 435 helix is a piece of ½-inch trim wood 2½ inches wide (vertical direction) tapered to ¾ inch at the tip, keeping the overall weight low. Tapered fiberglass poles could also be used here, or a truss structure like the WD4FAB 146-MHz antenna could be used for 435 MHz.

Question: *What polarization should be used? Are both LHCP and RHCP needed? If two helicals are used what spacing?*

On both AMSAT-OSCAR 7 and AMSAT-OSCAR 8 RHCP (was) is needed on 145.9 MHz for Modes B and J respectively. However, LHCP is very much needed for the Mode A uplinks on both satellites. This RHCP and LHCP difference is due to the internal details of phas-

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Design Parameters for VHF-UHF Helical Antennas

Data Source	*RSGB*	W7US	*QST*	WD4FAB	
Frequency	432	435	435	436	146
Wavelength				27.13 in.	80.90 in.
One-Turn Circumference, L				1 wavelength	1 wavelength
Turn Spacing, S	0.22 wavelength	0.25 wavelength	0.25 wavelength	0.25 wavelength	0.228 wavelength
Mean Helix Diameter, D	0.32 wavelength	0.33 wavelength	0.33 wavelength	0.308 wavelength	0.310 wavelength
Number of turns, N	(pick it)	6	9	6	6
Reflector Diameter, d	0.8 wavelength	1.03 wavelength	0.8 wavelength	1.03 wavelength	0.8 wavelength
Start, First Turn, F (see *QST* 6/81)	0.12 wavelength	0.12 wavelength	0.12 wavelength	0.12 wavelength	0.114 wavelength

$$D = (L/\pi)\cos(\sin^{-1}S/L)$$

ing the antennas and feeding to and from two transponders. Of course, AMSAT-OSCAR 7 is not now operational. Either RHCP or LHCP is very useful on AMSAT-OSCAR 8 operations on 435 MHz, but for a different reason. Neither AMSAT-OSCAR 7 or AMSAT-OSCAR 8 used a CP antenna array on 70 cm, just a simple whip antenna. Spacecraft spin and tumble motions cause a continuously moving linear polarization sense resulting in attendant signal fading if linear antennas are used at the ground station.

For Phase IIIB we will have both spacecraft spin motions and CP phases antenna arrays on the rf links. Although 70 cm will be used for both the Mode B uplink and the L Band transponder downlink, there will be no CP reversals as the 70 cm rf lines will be switched. At this time RHCP is the planned sense for 146 MHz (Mode B downlink), 435 MHz (Mode B uplink), 436 MHz (L Band downlink), and 1296 MHz (L Band uplink).

As far as having switchable CP senses to correct for Faraday Rotation, I feel that need for this refinement has yet to be really proven. If you feel the urge, a pair of helicals spaced one wavelength will suffice. An alternate is a high quality crossed Yagi antenna with a ¼ wave axial phase spacing. The KLM antennas are of that type construction and are easy to reverse polarization.

Question: *How about using 70-cm transceivers in the shack, such as the new Icom IC-451A, instead of putting all that radio gear up at the antenna like WD4FAB?*

I envy the amateur who can spring for an IC-451A for a satellite linkage. Low feed line losses are a must, 50-ohm foam hard line for very short runs and preferrably 7/8-inch heliax for any run. With really low loss line there will be no need for any remote transmitting equipment, and a remote preamplifier may not be needed, as shown by W1AW. Even so, my own preference would be for the remote preamp, a cavity filter, and a very good low-loss coaxial relay (to permit transmitting around the preamp). This 70 cm equipment can be set up now and well checked out on AMSAT-OSCAR 8-J before being needed on Phase IIIB. My own opinion is that a remote preamplifier with a low noise figure will also be needed for the Phase IIIB 145.9 MHz downlink.

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Comets

VK3ACR at the center of a station that covers 160m through 3 cm!

Transatlantic DX on OSCAR 8 Mode-J

By John Branegan,* GM4IHJ

More on the fun and challenge of "8J-DX" as viewed by one of the best. Here, John tells how to stretch your DX limit.

Operation on OSCAR 8J poses many problems for the newcomer. K9CIS has spelled out the solutions to most of these difficulties in his recent *ORBIT* reprint, and W9KDR has given pages of excellent advice in *QST*. By following this advice anyone can get aboard 8J for medium range QSOs. However those of us spoiled on OSCAR 7B, can be excused for asking for a little more—Is real DX available on 8J? In this article, GM4IHJ hopes to demonstrate that the answer is that DX is readily available. But, you have to work for it.

Where and When

Half the battle, is knowing where and when to expect DX. Fig. 1 shows just how far certain European stations can penetrate across North America with the help of 8J, Table 1 amplifies the data of Fig. 1, listing the orbits on which this mutual North American/European coverage is available. OSCAR 8J has provided a number of well-documented QSOs beyond a 6000 km range, without any obvious or special propagation assistance. It is therefore fair to say, that a sizable slice of North America is in range of Europe sometimes twice each day.

A reasonable picture of European/North American DX possibilities can be obtained with the aid of the excellent ARRL plotter, but at GM4IHJ this aspect has been carried a step further by using a computer. As shown in Fig. 2, the computer VDU screen is scaled to represent a section of North America bounded by longitudes 65 °W to 110 °W and latitudes 35 °N to 55°N. Several DX localities are defined at their correct latitudes and longitudes. Across this sector display, a set of five black squares set 5 ° apart in latitude move (giving longitude) in step with the leading edge of the 8J horizon footprint.

Using the simple graphics of a Sinclair ZX81, GM4IHJ has a real time or controlled display of just who is in or just moving into the 8J footprint as it moves across North America. On the day shown in Fig. 2, GM4IHJ had an opening QSO with 8J regular G8KQJ. At 1131Z as the footprint approached New York, GM4IHJ and G8KQJ agreed to split 5 kHz apart, to

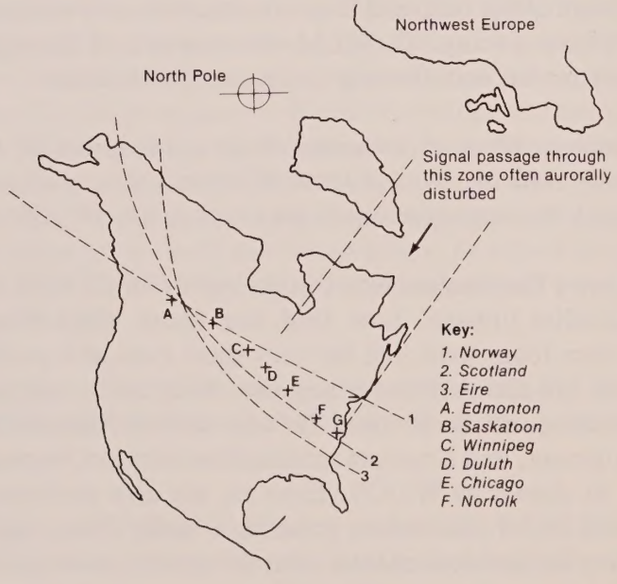

Fig. 1 — The footprint across North America.

*8 Whitehills, Saline, Fife, Scotland

Table 1. North American locations in range Europe via 8J

Eastern Standard Time	*Orbit EQX °W*	*Locations in range of Europe. Locations marked thus (*) have been worked or heard.*	*Remarks*
Late Afternoon	20° to 39°	VE1* and Maine*	
	24° to 39°	VE1* W1* W3 (Penn*) VE2* VE4 and VE5	
	32° to 39°	All above plus Carolina, Virginia, Kentucky Illinois, Minnesota, Wisconsin and Saskatchewan	From EI GI and GM only
	35° to 39°	Above plus 200 km	As above
Early Morning	214° to 280°	VE1* VE2* and North East Canada	
	223° to 250°	Above plus W1* W2* VE3*	
	229° to 236°	Above plus W3* Washington DC* Kentucky* Virginia	
	235° to 258°	Michigan and Indiana*	
	240° to 255°	Illinois, Wisconsin, Minnesota* and Saskatchewan	Only GM GI EI OY and GD.

NB. A station in New York City, is in range of the following active European countries: France, Eire, Jersey, Guernsey, N Ireland, Belgium, Holland, Luxenbourg, West Germany, Denmark, Sweden, Norway, England, Scotland, and Isle of Man.

look for North Americans. 30 seconds later GM4IHJ was in QSO with another regular 8J friend K2KUZ in Albany, NY. After about a minute and a half of excellent QSO, K2KUZ indicated he would QSY to leave GM4IHJ to go for some DX in his last two minutes of access. As K2KUZ cleared, the VDU display for 1134Z indicated that Lexington, Kentucky was nearly in range, and right on the button, up came Shep, W4AUZ, calling GM4IHJ for an excellent QSO, before GM4IHJ left the eastern edge of the footprint.

Operating Technique

In case the reader should think that the above report of 8J DX sounds too easy, be assured that it is not. GM4IHJ and W4AUZ nearly made it on 8J in September 80. In August 81, after two months of listening for GM4IHJ on orbits around EQX 230°, Shep finally caught him for a really solid QSO which has since been repeated several times.

Once a QSO has been achieved, it is easily done again, but for that first QSO a great deal of attention to detail is necessary. Time on 8J is limited. If you send non stop CQs for two solid minutes, while the DX vainly plasters his signal above you, across you, and around you—you will not get many QSOs. Europeans are already firmly on 8J as orbits reach North America, so please listen for them. Then if you have previously noted down the exact uplink frequency needed to hit a definite downlink frequency on that EQX/Doppler, you can hit the DX right on the nose. You may get a good QSO, while the Dit Dah chaser is still wondering where he is. Additionally helpful are North American operators who send their callsign *whether they hear their own signal return or not*. They are more than half way to 8J DX right from the start, because the operator at the other end knows instantly who is accessing. DitDitters and IMIers who do not identify rarely get QSOs.

At GM4IHJ a standard short procedure is used, with break in encouraged. The call is "CQ 8J de GM4IHJ" plus five second break for any takers. This changes to "QRZ 8J de GM4IHJ" if something is heard and goes to "W6DXR de GM4IHJ 55N BK" as soon as someone is identified. There is room for lots of variations on this theme, but please keep it short, and, please avoid non essentials until the QSO is firmly sealed.

While calling, GM4IHJ tunes ±5 kHz. It is unnecessary for other stations to get exactly on tune, just get somewhere near, and of course being good DX men no one ever gives the classic reply "GM4IHJ GM4IHJ GM4IHJ GM4IHJ GM4IHJ GM4IHJ de Blurp bleep." However some stations do make the mistake of emphasizing the wrong callsign. Please remember that it is *your* callsign you need to get across—You may know it but the man at the other end, by now keyed up to make a QSO, hasn't a clue who you are, until you tell him.

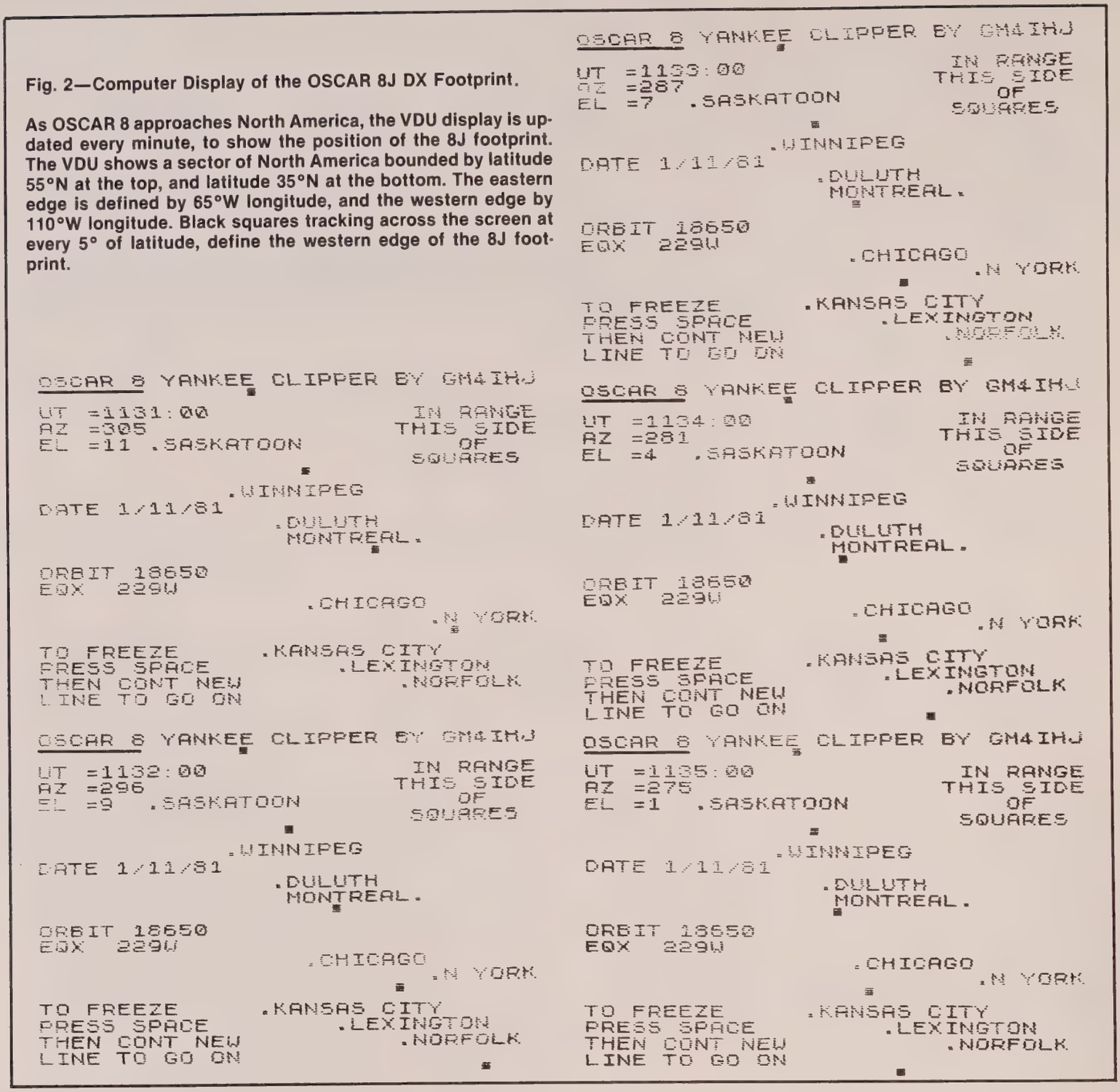

Fig. 2—Computer Display of the OSCAR 8J DX Footprint.

As OSCAR 8 approaches North America, the VDU display is updated every minute, to show the position of the 8J footprint. The VDU shows a sector of North America bounded by latitude 55°N at the top, and latitude 35°N at the bottom. The eastern edge is defined by 65°W longitude, and the western edge by 110°W longitude. Black squares tracking across the screen at every 5° of latitude, define the western edge of the 8J footprint.

Propagation, Equipment and Other Factors

In the past year W2 to Holland, W9 and W4 to Scotland, have been worked several times, and Scottish signals have been heard beyond the Great Lakes into Minnesota. For other parts of the world, this implies that Capetown to Rio, Hokkaido to Hawaii and Brisbane to Singapore are all possible. Indeed, these circuits, free the problems of the Europe/North America transauroral passage, should be possible regularly. However it must be admitted that 8J is often subject to propagation disturbance—the power margin is extremely small, compared say with OSCAR 7B, and signals are often badly cut up by scintillation. The best possible low noise receiving equipment helps overcome some of the problems and, on the transmit side, several 8J DXers have had success with switchable uplink polarization or dedicated horizontal polarization for the low elevation sections of 8J passes. In this respect there seems to be a growing amount of evidence to suggest that 8J prefers, a horizontally polarized uplink signal, when it is low on your horizon.

The Future

GM4IHJ will be aiming to appear on all 8J orbits EQXs 220° to 255°W and, 22° to 39°W, through winter 81/82 to summer 82. Please be assured that any North American station is good DX for Europeans. Indeed a contact with a W2 or VE2 often attracts a W3 or W4 so that the lucky European gets two DX contacts per orbit. So wherever you are, you are most welcome.

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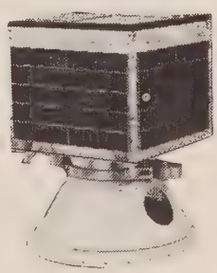

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High Eccentricity Orbits Simplified

By Greg Roberts,* ZS1BI

The complexities of elliptical orbits are de-mystified by a Ham/Astronomer.

Several articles have appeared in various publications predicting the ground track of a Phase III satellite so as to easily determine where it will be at a particular instant and what sort of coverage it will provide. In my opinion, most of the authors leave the average amateur somewhat confused. Hopefully, this article will remove some of the confusion. I do not propose to answer all the questions that might be asked but will deal only with the calculation of a ground track overlay as this is probably the most difficult task. As in all computations involving elliptical orbits, it is useful, but not essential, to have a programmable calculator, or a personal computer because some of the calculations are time consuming and it is easy to make a mistake.

Unlike previous amateur satellites which move in essentially circular orbits and thus permit considerable simplifications in "orbit prediction," in the new era, amateur satellites will move in very elongated or elliptical orbits. Some of the techniques used for circular orbits would no longer be valid since the satellite will not move with constant velocity, but would be moving most rapidly when closest to earth (perigee) and slowest when furthest away (apogee). There is also the added complication that the position of the perigee location slowly moves around the orbit plane, which means that a new ground track will have to be determined at regular intervals.

Definitions

Before starting the calculations, it will be advantageous to begin with some definitions. The purists may shudder at some of them, but I have tried to put them in a form so that most amateurs will understand. Normally, the assumption is made that the amateur knows something about orbital mechanics, but it has been my experience that the average amateur hasn't a clue about what is going on, and he gets bogged down very soon. The mere mention of mathematics is enough to scare many amateurs off for life!

(1)Mean Motion: This is usually denoted by the letter "n" and is defined by

$$n = \frac{360 \text{ degrees}}{\text{period in minutes}} = \text{deg/min.}$$

This implies a fictitious satellite that is moving around the earth at a constant velocity (i.e., our circular orbit) and is not true for an elliptical orbit. However, with some mathematical juggling we can later correct this "error."

(2) Mean Anomaly: This is denoted by "MA" and is the position at some point in the orbit at a time "t" after some specific instant. For our purposes MA = 0 degrees when t = 0 minutes and this is actually the position of perigee. The mean anomaly at any time, t, is given by:

$$MA \text{ (degrees)} = nt$$

(3) Argument of Perigee: The angle between the equator and the perigee point on the ellipse, measured at the center of the earth and in the ascending direction. The symbol for this is the small Greek symbol for omega and we will call it "W." When the perigee point occurs on the equator at the ascending node, W is 0 degrees, and when it occurs on the descending node W is 180 degrees. The argument of perigee can have any value between 0 and 360 degrees. It is this variable which makes it necessary to compute the ground track at regular intervals for elliptical orbits.

(4) Eccentricity: This is denoted by the letter "e" and defines the shape or "flatness" of an orbit. If the orbit is truly circular, e = 0, but if the orbit is very flat, it can go up to a maximum value of e = 1.0. Beyond this point

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Table 1

Phase IIIA

Apogee = 35786.0 kilometers
Perigee = 1500.0 kilometers
Inclination = 57.00 degrees
Period = 656.2000 minutes

Semimajor axis = 25014.00 kilometers
Eccentricity = .685336
Mean Motion = .5486132 deg/min.

Time minutes	E degrees	V degrees	Height km	210.000 long.	Degrees lat.	240.000 long.	Degrees lat.
0.0	0.000	0.000	1500.0	162.54	-24.79	136.67	-46.58
20.0	31.141	65.634	3970.3	84.73	-56.58	42.23	-42.97
40.0	53.154	98.364	8363.0	44.53	-41.12	22.19	-18.01
60.0	69.430	116.099	12619.9	35.10	-27.89	17.13	-3.27
80.0	82.561	127.589	16423.4	32.66	-18.65	15.85	6.36
100.0	93.777	135.952	19772.2	32.76	-11.75	16.15	13.33
120.0	103.721	142.517	22709.1	34.09	-6.27	17.28	18.73
140.0	112.767	147.945	25277.1	36.12	-1.72	18.88	23.14
160.0	121.154	152.608	27511.7	38.58	2.19	20.79	26.87
180.0	129.041	156.730	29441.1	41.32	5.64	22.88	30.10
200.0	136.546	160.460	31087.5	44.26	8.76	25.08	32.97
220.0	143.754	163.901	32468.6	47.32	11.62	27.34	35.56
240.0	150.733	167.126	33597.8	50.47	14.30	29.60	37.92
260.0	157.539	170.193	34485.6	53.67	16.83	31.83	40.11
280.0	164.219	173.146	35139.8	56.89	19.25	34.00	42.15
300.0	170.812	176.023	35566.0	60.11	21.59	36.06	44.07
320.0	177.356	178.857	35767.7	63.29	23.88	37.97	45.87
340.0	183.886	181.679	35746.6	66.42	26.13	39.70	47.59
360.0	190.436	184.520	35502.4	69.46	28.38	41.19	49.21
380.0	197.043	187.409	35033.2	72.39	30.63	42.38	50.74
400.0	203.743	190.380	34335.1	75.15	32.91	43.21	52.18
420.0	210.578	193.473	33402.1	77.69	35.24	43.58	53.52
440.0	217.596	196.734	32225.9	79.94	37.64	43.41	54.72
460.0	224.855	200.224	30795.6	81.81	40.13	42.56	55.74
480.0	232.425	204.019	29096.8	83.12	42.74	40.89	56.52
500.0	240.397	208.231	27111.4	83.67	45.48	38.25	56.96
520.0	248.895	213.018	24815.8	83.07	48.36	34.47	56.88
540.0	258.091	218.628	22180.7	80.70	51.35	29.43	56.01
560.0	268.242	225.471	19169.0	75.45	54.28	23.06	53.93
580.0	279.760	234.295	15736.8	65.39	56.57	15.35	49.85
600.0	293.366	246.641	11843.9	47.93	56.41	6.21	42.29
620.0	310.472	266.255	7515.9	22.83	48.78	354.99	27.77
640.0	334.041	303.847	3229.6	354.97	21.69	337.90	-3.23
656.2	360.000	360.000	1500.0	326.59	-24.79	300.72	-46.58

the "elliptical" orbit is not longer elliptical but is either parabolic or hyperbolic and is no longer a closed or periodic orbit.

Suppose the maximum height (apogee) of the satellite above the Earth's surface is H kilometers and the minimum height (perigee) is h kilometers. Let the mean radius of the earth be 6371 kilometers, then the semimajor axis, denoted by "a" is given by

$$a = \frac{(H + 6371) + (h + 6371)}{2}$$

and the eccentricity "e" is given by

$$e = \frac{(H + 6371) - a}{a}$$

With some juggling, two additional formulae can be determined, namely

$$H = a(1 + e)$$
$$h = a(1 - e)$$

In this case both the apogee (H) and perigee (h) values are the distance from the center of the earth.

The value of *a* is useful because the orbital period is directly related to it. So are several other terms that accurately describe the behavior of the satellite orbit, but for our purpose we need not concern ourselves with them.

(5) Eccentric Anomaly: This angle is measured at the center of the elliptical orbit, measuring from the center of the Earth to the projection of the satellite position on the elliptical orbit onto the circumscribed circle, with the projection being perpendicular to the line joining the

center of the Earth and the center of the ellipse. If this confuses you, careful study of Fig. 1 will solve the problem. It is denoted by "E."

(6) True Anomaly: This angle, denoted by "V," is given by the position of the satellite along the ellipse, measured at the Earth's center and starting from the perigee location. Fig. 1 should again help.

(7) Inclination: This is the angle made by the orbit plane, in the ascending direction, with the equatorial plane of the earth. It is denoted by the letter "i" if it is less than 90 degrees, the orbit is said to be posigrade, or if greater than 90 degrees, the orbit is termed retrograde. When it is equal to 90 degrees, the orbit is polar.

(8) Period: This is the time taken for the satellite to complete one revolution and is usually measured in minutes and denoted by "P." There are various kinds of periods, e.g. *nodal* and *anomalistic* to name two, but these need not concern us, as the variation is small and will not noticeably affect the usefulness of the ground track derived. If one really wants to do precise orbital work, one would forget the ground track method.

Computational Procedure

Suppose the position of the satellite at a time "t" from the starting point (in our case perigee position) is required. Let the period be P minutes and the eccentricity "e," then:

$$\text{mean motion, } n = \frac{360}{P} \qquad (2.1)$$

and the mean anomaly is:

$$\text{Mean anomaly "MA"} = nt \qquad (2.2)$$

Now determine the eccentric anomaly E from:

$$MA = E - ke(\sin E) \qquad (2.3)$$

where $K = 57.2958$ *degrees.*

This equation does not have a simple solution and it is necessary to do successive iterations or "loops." It is time consuming, but fortunately the method outlined converges very rapidly. I have never found it necessary to "loop" more than five or six times.

As a first approximation, the eccentric anomaly E is given by:

$$E_1 = MA + ke \sin MA\,[1.0 + e(\cos MA)] \qquad (2.4)$$

where E_1 *and MA are in degrees.*

Now determine the mean anomaly corresponding to this value of E with:

$$MA_0 = E_1 - ke(\sin E_1) \qquad (2.5)$$

This gives the error in the mean anomaly as:

$$dMA = MA - MA_0 \qquad (2.6)$$

and hence a correction dE can be obtained from:

$$dE = \frac{dMA}{1.0 - e(\cos E_1)} \qquad (2.7)$$

which then gives a new value of E of:

$$E_{new} = E_1 + dE \qquad (2.8)$$

This completes the first determination of E and will be pretty close, but not good enough, for highly eccentric orbits. The process needs to be repeated and the new value of E is recycled or "looped" back to equation (2.5). Repeat equations (2.5) to (2.8) until dE is as small as required. With an e of 0.7, it required four "loops" to get a dE less than 0.0001 degrees and by the time seven loops had been done dE was less than 0.000000001 degrees. For our purposes a maximum of four "loops" will be entirely adequate.

With the final value of E now proceed to determine the true anomaly V which is given by:

$$V = 2 \arctan\sqrt{\frac{1+e}{1-e}} \quad \tan\left[\frac{E}{2}\right] \qquad (2.9)$$

(Note: Add 360 degrees if E is greater than 180 degrees.) The height of the satellite above the Earth's surface at this point is:

$$\text{Height (km)} = a(1.0 - e\cos E) - 6371 \qquad (2.10)$$

This concludes the calculations for a particular value of t and the procedure can be repeated at whatever time interval is required. It will probably be worthwhile to determine the required details at 20-minute increments. However, one can use larger increments, especially when the satellite is near apogee or smaller increments if it is at perigee. This is because the corresponding changes are small at apogee and largest at perigee. The foregoing series of computations will normally be done for one orbit only and this will hold for a particular orbit unless the period or eccentricity experiences large changes. One then ends with a table as follows:

Time	E	V	Height
0			
20	etc.	etc.	etc.
40			

Table I

The interesting part now comes and has to be calculated for every argument of perigee (W) chosen and will provide the subsatellite track, or ground track, in longitude and latitude.

Determine the value of *D* where:

$$D = W + V \qquad (2.11)$$

If the value of D is greater than 360 degrees, subtract 360 degrees until D is in the range 0 to 360 degrees.

The latitude of the subsatellite point is given by:

$$\text{latitude} = \arcsin[(\sin i)(\sin D)] \qquad (2.12)$$

If the angle comes out negative, the latitude is in the southern hemisphere, and if positive, it's in the northern hemisphere.

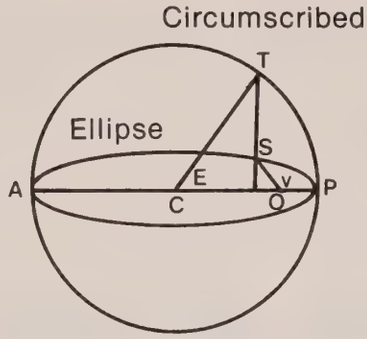
Finally, the longitude is given by:

$$\text{longitude} = 360 - \arctan[(\cos i)(\tan D)] + 0.25t \qquad (2.13)$$

(Note: Substitute a positive 180 degrees for 360 if cos D is negative.)
The value 0.25t represents the correction for the Earth's rotation. A better value would be 0.25068t but using this number is perhaps unnecessary since the maximum error with 0.25 is only a quarter degree for a 660-minute orbit.

Finally end up with a set of tables similar to that shown in Table 1. The first four columns are fixed for a particular P and e combination. Two values of perigee argument—one of 210 degrees, the other 240 degrees—have been determined to show the difference.

If this table is plotted on a suitable map projection, it will be easily seen how the satellite moves and where it varies speed. Fig. 2 shows Table 1 plotted on a Mercator projection, and it is interesting to see how the satellite moves rapidly in the southern hemisphere and slows down as it approaches apogee, to speed up once again as it heads towards perigee in the southern hemisphere.



O = Earth's Center
e = eccentricity
a = semimajor axis = CP = AC
OA = radius of apogee = a(1 + e)
OP = radius of perigee = a[1 − e(cos E)]
V = true anomaly = angle P O S
E = eccentric anomaly = angle P C T

Fig. 1

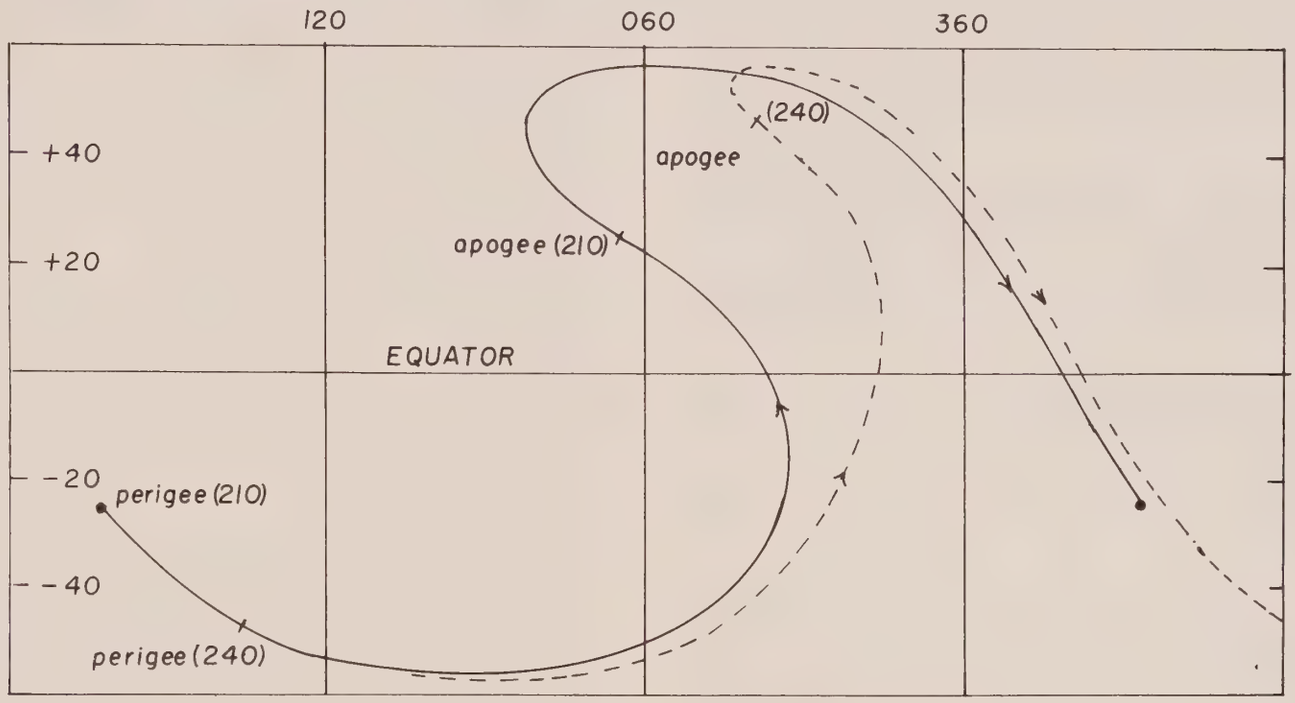


Fig. 2 — Table I plotted on a Mercator projection.

Ellipsis... (The Editorial continues from page 3)

fortunate because the tether is now pulled taut. The crowding of the 2-meter band in some regions makes even Mode B of Phase IIIB look like a temporary solution. So it's on to the vast spectral Serengeti plains where grand schemes can be played out with the coming super-performance transponders. The promise of multi-MHz-wide resources free from the competitive excesses of the carnage below is alluring indeed.

The herd *is* moving. It's probably too soon to judge if the rate is adequate. An answer to our question posed above will have to wait to see how well Phase IIIB and C are accepted. Many eyes will be watching.

Meanwhile, those leading must be ever sensitive to the need for pacing; those tending to tarry when it's time to move must be gently prodded or lost to predators. Only in this way can maximum benefit accrue to the community at large.

Art may flourish in crisis; science certainly does not. With the awful din of 20 meters in one ear, let us move smartly on to more serene pastures. We simply must evolve. It is inevitable; it is healthy; it is warranted; it is time and it is critical to survival!

Part II

Fred Works OSCAR

By Joe Kasser,* G3ZCZ/4X

Part I of this beginner's series appeared in the previous issue. The story of Fred continues here.

"Pat" said Fred, "Are you using a preamplifier in the antenna line?"

"Yes," said Pat. "I've got the same one that you have."

"Well, why were signals so much stronger here than they were at my place?"

"Well" rejoined Pat, "It's a function of the antenna."

"How's that" asked Fred. "My dipole works pretty well on 10."

"Yes, but satellite signals behave differently than terrestrial signals" answered Pat reaching for a notepad and pencil. "Consider the factors involved. Look at this sketch.[8] Conventional or terrestrial QSO's use the ionospheric reflection to convey signals from one station to the other. OSCAR QSO's use a satellite to retransmit the signals; each medium has different propagation characteristics."

"Why?" asked Fred. "Surely they are the same. I mean there's no difference between bouncing a signal off the ionosphere or bouncing it off a satellite except that the frequency changes in the satellite's on-board transponder. Is there?"

"Well," said Pat. "Yes and no."

At that moment the intercom buzzed. Pat picked it up and listened momentarily. "That's very nice Love" he said and replaced the intercom unit.

"Norma has made a pot of tea" announced Pat. "Let's adjourn to the kitchen." Pat secured the shack powering-down the receiver and grounding the antennas. Fred and Pat then joined Norma in enjoying a cup of tea.

At last Fred was able to ask, "Explain that yes and no answer, please."

"OK" said Pat. "Let's take a brief look at those 10 meter signals." They are affected by a number of things. First, the ionosphere has an effect on them. In the terrestrial mode the signals are *reflected* back to earth and in the satellite mode they pass through it."

"That's simple enough" said Fred. "Everybody knows that."

"Yes" replied Pat, "But ...."

"There's always a but" laughed Fred.

"When signals go into the ionosphere they may or may not be reflected back depending on conditions. The density of the ionosphere is a function of solar activity and it determines the maximum frequency that will be reflected. That's why 10 meters is 'open' during the day and 'closed' at night."

"Because the sun's shining on it by day" interrupted Fred.

"More or less" agreed Pat.[9] "Another factor to consider is the angle that the signals enter the ionosphere."

"How come?" asked Fred.

"Look at this" said Pat reaching for his notebook.

"Signals are reflected back by being gradually refracted. That means as the signal enters the ionosphere it begins to curve back towards the earth. If we could look at it end-on, it would seem to bend[10]. If this bending effect is constant, then a signal entering at a different angle would be refracted but not enough to come out again on our side of the ionosphere. It would be bent a bit, all right, but would pass right through. Signals entering the ionosphere at some intermediate

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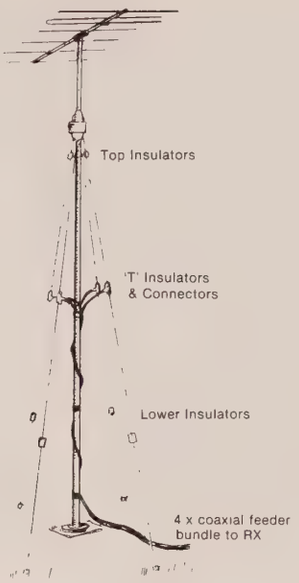


Fig. 2—All-round sloper for 29.450 MHz.

angle would be reflected but would emerge at different places. At hf this means that low angle radiation emerges from the ionosphere and bounces the farthest. That's why low angle radiation is favored by DX'ers. The signal traveling through the ionosphere is also subject to Faraday rotation. This means that its plane of polarization changes. Thus, a polarized signal entering the ionosphere usually emerges rotated by an appreciable and variable amount."

"So why don't we notice this on hf?" asked Fred.

"We do" said Pat. "But since the changes are gradual they may not be noticed during the course of a QSO or we may notice it as QSB. This is one reason why a Quad antenna, which has components sensitive to both vertical and horizontal polarization, does so well. Anyhow, the problem is compounded in the OSCAR mode because we have two signals going through the ionosphere."

"Two signals?" echoed Fred.

"Yes, the uplink and the downlink. Normally these signals are so high in frequency that they pass right through the ionosphere with a minimum amount of scatter or reflection. Occasionally the solar activity gets high enough to bother the 29 MHz downlink and on some occasions it may even bother signals at 145 MHz.[11] Since the effect of the ionosphere will be different at the different frequencies, the actual signals that we receive will have apparently random changes in polarization and intensity. We notice these effects as QSB. We can compensate for the polarization changes by switching the polarization of the receiving antenna."

"Is that what you were doing during the pass?" asked Fred.

"You bet" smiled Pat. "What we can't compensate for is the absorption of attenuation in the ionosphere, we just have to build sufficient fade margin into the system to take care of it."

"Fade margin?" asked Fred. "What's that?"

"That's a technical term that the professionals use. It means that we have to have enough gain in our receiving system to compensate for fades."

"I still don't understand" said Fred, with a puzzled look on his face.

"Well" said Pat, "Look at it this way. In a practical sense it means that we get the best receiving setup that we can and copy all signals loud and clear generally. When they do fade, however, we still have sufficient gain to copy them at the point of maximum fading. For example, if we are listening to a signal at S9 and it fades down to S3, we can still copy it. If that same signal was only S4 to start with and it fades down six 'S' units, we would not be able to copy it if S3 were the minimum level that we could receive. We would have to have a fade margin of six 'S' units in the system to be sure that we could still copy the signal during fading or QSB."

"So fade margin is just a fancy way of defining the difference between the signal level that we are receiving and the minimum level needed to copy the signal" Fred declared triumphantly.

"That's right" responded Pat. "And it's usually measured in dB but in our case we are using 'S' units since most receivers have 'S' meters which measure relative signal levels."

"How do we relate 'S' units to dB?" asked Fred.

"Let's put that one aside for the moment because we are still talking OSCAR."

"OK" allowed Fred. "What else affects our signal readability?"

"Well" said Pat. "There's QRM and QRN at 29 MHz. This is caused by other hams operating direct on 10 meters. QRM. Also in the passband are noise generated by power lines, TV line oscillator harmonics, appliance motors and other switching devices. That's not to mention the natural noise of thunder storms and so forth. QRN."

"Sounds like a severe problem" said Fred.

"Let's call it a stern challenge" Pat reflected. "But luckily most of the QRM is from low angle signals while the OSCAR signals that we want to copy are high angle."

"Huh?" Fred wrinkled his brow.

"Well, most of that manmade noise—machines, TV, etc., are local and are generated at ground level. The satellite, however, is traveling high in the sky and so its signals are coming in at high angles. Of course when the satellite gets down to the horizon at AOS[12] or LOS, it will also be sending us low angle signals."

"OK. That's clear enough. What else is there to consider?" Fred pursued.

"There's the satellite itself!" Pat exclaimed.

"What about it?" responded Fred.

"Well, the satellite is transmitting at low power levels. It has an output of the order of one watt and that power is shared by all the signals in the passband. If a strong signal is received by OSCAR, it may 'capture' the AGC and attenuate all the signals in the passband. We

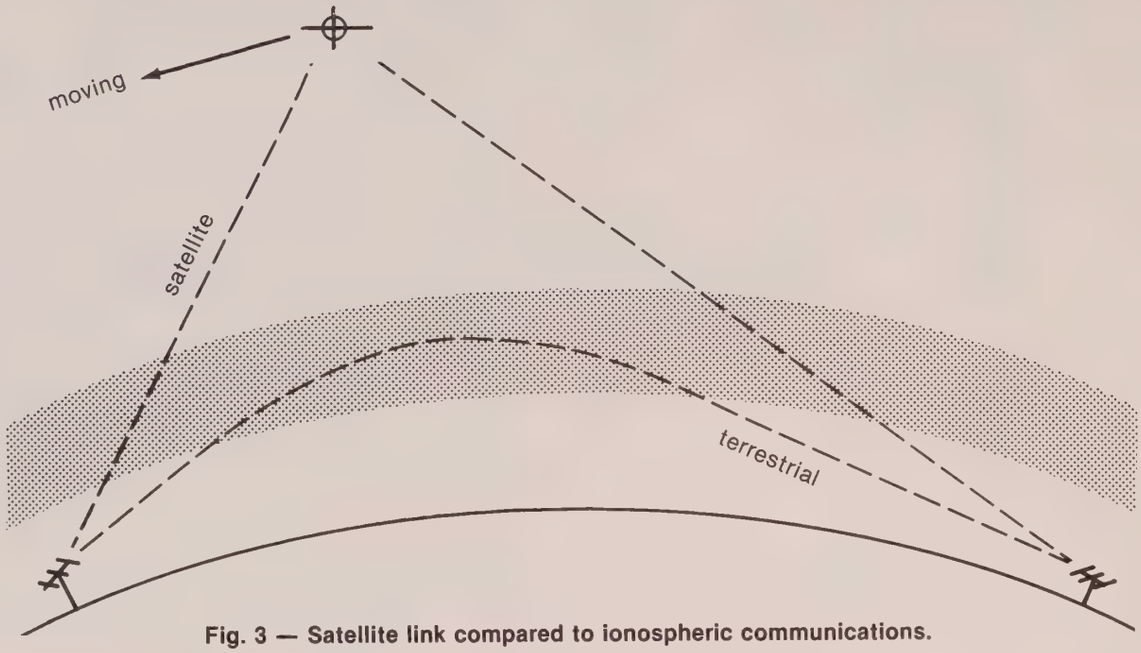


Fig. 3 — Satellite link compared to ionospheric communications.

didn't notice that effect tonight, but many times I've been able to put a constant low-level carrier into a satellite and have heard it being 'pumped' off and on by some crocodile."

"Crocodile[13]?" interrupted Fred.

"Yes, a crocodile is a reptile with a large mouth and tiny ears. We use that term to describe a station that has a poor receiving setup and thus has to pump a lot of power into a satellite to receive his own signals. These people miss out on a lot of the OSCAR fun and spoil it for others."

"They miss out on the fun because they can't hear people calling them," said Fred, "but how do they spoil it for others?"

"Because people get frustrated calling them and not getting a reply," said Pat. "And, their high power causes QRM to everybody else in the passband."

At this point Norma came back with a new pot of tea and the discussion was interrupted. It was while they were drinking the tea that Pat noticed the time.

"Great Scott" he exclaimed. "There's another AMSAT-OSCAR 8 Mode A pass about now."

Gulping down the tea, they sped down to the shack to find the pass in full bloom. Fred once again tuned the receiver and enjoyed himself. The pass lasted only ten minutes and then signals vanished as abruptly as they had done before when AMSAT-OSCAR 8 went below their horizon (LOS).

"Let's go back and finish off those biscuits[14] that Norma made," said Pat.

"OK," said Fred. "They really are good!"

Once the biscuits had been enjoyed and yet another cup of tea downed, the discussion continued.

"Another factor to consider is the antenna used on the spacecraft" said Pat recommencing the discussion where they had left it.

"Let's summarize," said Fred. "The signals in an OSCAR QSO are affected by the ionosphere, noise and the satellite itself. By the way, why do we keep saying AMSAT-OSCAR? That's quite a mouthful."

"Well, OSCAR is the generic term for an amateur radio satellite. It's an acronym for *O*rbiting *S*atellite *C*arrying *A*mateur *R*adio. AMSAT, or the Radio Amateur Satellite Corporation is the organization that built the latest ones. The number 8 means, of course, that it is the eighth spacecraft in the series to be successfully launched into orbit."

"OK" said Fred. "But it is still a mouthful."

"The early OSCAR's were just called OSCAR because they were built by Project OSCAR Inc. OSCAR 5 was built in Australia, so it was known as AUSTRALIS-OSCAR 5. The two amateur radio satellites RS1 and 2 (Radio Sputnik 1 and 2) launched by the USSR could have been called Sputnik-OSCAR 9 and 10 or equivalent if they had wanted it done that way."

"OK, OK" said Fred. "Now getting back to Mode A. We've covered the propagation and path effects. How does that help in my choice of antennas?"

"Ideally you need an antenna with no cross-polarization losses, minimum noise capture, gain in the desired direction and attenuation in other directions."

"Say that in English" Fred pleaded.

"What you need is an antenna that always has the same polarization as the signal it receives,[16] does not pick up any manmade noise, is rotatable and has a high front-to-back ratio."

"Does one exist?"

"Well, it's a little difficult to make one at 29 MHz but we can approximate it."

"How?" Fred quickly responded leaning forward slightly now.

"OK. If we use a circularly polarized antenna we can

be sure that we will not get any QSB due to changes in the polarization of the signal. If we add to that some sort of reflectors and directors, we can get a good front-to-back ratio. If we then make it rotatable, we get the gain in the desired direction and if we put it up high, we minimize the manmade noise."

"So, all we want is some sort of beam antenna with eight or more elements about six wavelengths up in the air" Fred concluded. "That works out to a boom length of at least 60 feet at a height of about 190 feet. You must be joking."

"I did say that we could approximate it" said Pat. "I didn't say that we could make it! Look. We needed an antenna with low-angle lobes, minimum noise capture, gain in one direction and minimum pickup in others at G4ANT (the Mosley Antenna Plant Club Station) for 80 meter contest work. After trying numerous aerials to try and put the best signal into North America during contests, we finally came up with one that worked like a bomb.[17] We merely suspended a dipole from a mast at about 30° with the base staked out in the direction we wanted to communicate with, that is South-West. By using one of the towers that supported the hf Yagis and Quads as a passive reflector we got a few dB of gain in the desired direction and several dB of attenuation where that was desired. Sloping the antenna reduced the capture angle at the horizon so we minimized noise pickup. This antenna was a real winner and with it we put up our best 80 meter performance to date."

Pat continued. "I built a similar antenna for 29.45 MHz because I wanted to work horizon DX via AMSAT-OSCAR 7. It looks like this." Pat sketched the drawing shown. "This antenna was a great improvement, as KL7 and the rest of the distant North-West areas now boomed in. What's more, the antenna worked favorably over and above my regular three-element Yagi at most of the times when deep QSB manifested itself on the Yagi."

(To be continued in a future issue)

[8]See Fig. 2.

[9]This is a general discussion that deals with the factors involved and may not be correct in every detail.

[10]See Fig. 3.

[11]"Sporadic E Impact on Satellite Signals," John Branegan, GM4IHJ, *ORBIT* Magazine #4, Nov./Dec. 1980.

[12]Aquisition of signals—once the satellite comes above Fred's radio horizon, he is able to acquire (receive) the signals.

[13]Referred to as an alligator in the USA.

[14]Cookies (and Norma really does make good ones).

[16]But not necessarily that of the signal as transmitted due to the effects of Faraday rotation (rotation of the plane of polarization as the signal passes through the ionosphere).

[17]English slang for working exceptionally well.

Book Topics: "The New Weather Satellite Handbook"

Reviewed by Noel J. Petit, WBØVGI

Oh! What I would have given to have had this book two years ago. I started searching for the GOES satellites in 1979 and had struggled through misinformation and plain ignorance until now I can claim to be on the right track with weather satellites. But with Ralph Taggart's book, you can catch me in a week!

This is an excellent primer on all aspects of reception of weather satellite images. The handbook covers satellites, receivers, antennas, CRT displays, direct printing of the images on paper, locating and tracking the satellites and numerous hints on operating satellite receiving systems. The amateur who wants to get started in this field should start with this book and go from there. For those who have already dabbled with satellites, this book will give you many ideas on improving the reliability and enjoyment of your present system.

I found one new idea in the antenna chapter. This chapter gives details on construction of vhf and S-band antennas. The "Zapper" omnidirectional antenna took about four hours to construct and works as good as my Yagi-equipped tracking system without the troubles of moving the Yagi. There are detailed plans for 1691 MHz parabolic dishes and feed horns. This excellent section presents some of the simplest microwave antenna designs I've seen. Most of the antennas presented can be built with handtools. Thus, even the beginner should be able to build the vhf and S-band antennas from plans in the handbook. All of the construction materials are available from electronic and hobby stores. One additional comment needs to be made about 1691 parabolic antennas. The handbook does not point out that the dish need not be very accurate to be effective. At this wavelength (17.74 cm), the surface tolerance of this dish need be no better than plus or minus 1 cm. Therefore it is not difficult to make a good parabolic dish, even with a simple uhf TV dish designed for far lower frequencies.

One of the major difficulties with the various satellites is the wide range of bandwidth transmitted from the various sources. The handbook discusses these problems in detail. This discussion should be read carefully—especially by those who plan to convert surplus receivers for satellite use. The handbook tells us how to use various commercial models of receivers and scanners.

For those planning to build a 1691 MHz receiving system from plans in the "new Handbook" I have some good news and some bad news. The bad news is that there is no plan for a 1691 system in the book; the good news is that the majority of amateurs couldn't build a useable microwave converter without considerable experience and equipment. My advice is the same as Dr. Taggart's: buy a commercial converter. Though I was a bit disappointed that the handbook had no downconverter plans, I now feel that such plans would only disappoint anyone who tried and failed. However, here is an excellent opportunity for the budding rf designer. Please, someone design a stripline downconverter with sufficient stability and sensitivity for 1296, 1691 and 2304 MHz use, but simple enough to build without a microwave design lab in the basement!

For those with a 1691 MHz downconverter, the handbook has helpful hints on weatherproofing and stabilizing the frequency determining elements of the converter.

The best chapters of the handbook are those with plans and circuit board designs for CRT and direct-paper-printing image display devices. For many satellite users, the display is the hardest to operate; both of the designs from the handbook should provide acceptable images from simple-to-build equipment. Included are numerous pictures showing the results of properly and improperly aligned display systems. These are invaluable for troubleshooting new image devices.

If you want to spend more than two years of the prime of your life searching for these satellite signals, go ahead. But take it from one who's been there: save these years for other adventures and buy Dr. Ralph Taggart's *New Weather Satellite Handbook*. It's better than finding the fountain of youth.

Soviet Satellite Operations

Front cover of *Radio* Magazine

Considerable interest has been generated by the launch of six Soviet Amateur Radio Satellites. A recent issue of AMSAT Satellite Report *gave some subjective comments about the operation as it appears from the photographs and words in the Soviet* Radio *Magazine. It is reprinted here for the benefit of all AMSAT members and others who may have missed that particular issue of* ASR.

The January issue of the Russian amateur radio magazine *RADIO* provides some tantalizing clues to the nature of the new satellites called *RADIO* 3 through 8. The cover, cover story and photo captions translated by Dex Anderson, W4KM, reveal new aspects of the birds not announced previously and suggest further possibilities.

The cover photo shows the central command and control center at the DOSAAF/USSR facility in Moscow. The array is apparently installed on the roof of an office building in or near city center. The antenna structure is an arrangement unlike anything we have seen. The best guess is that the az-el mount originally supported a parabolic dish in the 20 foot class and that it now has been converted for use with yagi-type antennas. At the center of the structure in the midst of an unbelieveable mass of tubular struts is a 2 meter crossed yagi having perhaps 7 or 8 elements in each plane. The type of feed used is not apparent. A very large reflector screen is apparently employed. The use of circular polarization on the new RADIOs is not a surpise. Several observers have reported an apparent preference for RHCP on the RADIO uplinks. Also in the photo is what quite plainly is a 70 cm linearly polarized yagi of about 14 elements. One is left to ask what this is doing here. There would seem to be at least three possibilities. 1. Use with Mode B and or J. 2. A 70 cm command link for the RADIOs. 3. An unannounced 70 cm transponder input or output on the RADIOs. Perhaps it is some combination of all three.

On the inside cover there are three photos. Two of the photos are of individuals connected with the program from both the official side and the user side. The official side is shown in the person of the Chairman of the Federation of Radiosport. Presumably subordinate to him is a member of the Satellite Coordination Committee. Finally there is shown the deputy technical project leader, Boris Lebedev, UA3ADI, who one might surmise is the Gordon Hardman, KE3O/ZS1FE, or Ulrich Mueller, DK4VW, of DOSAAF. The third photo on this page is quite revealing. It shows what is apparently one of the new satellites in a public display context. We can learn several things from the photo. First, the satellite appears much larger than one might expect. One might guess the roughly cylindrical cross section has a diameter of one meter or so (About 40''). Approx-

imately 80% of the surface is covered with solar cells giving the impression of a powerful device able to support the several devices aboard quite easily. The antenna structures are easily located. Diametrically opposed on the sides of the cylinder are two ten meter antenna deployment mechanisms. These appear to dispense a metallic tape about 10 cm wide. From the color of the tape and the apparent torsion it would appear that the tape is made of spring copper (berrylium alloy copper) or copper plated steel. At the top of the spacecraft are a series of rods which, because of the way the picture is cropped, are more difficult to interpret. It is likely, however, that the four rods seen from a canted turnstile for 2 meters with each rod angled about 30 degrees to the main axis of the spacecraft. (This would seem to confirm the notion of circular polarization which is in turn supported by a system block diagram showing two uplink antennas feeding a combiner/shifter.) Finally, on close inspection there appears to be still another antenna atop the spacecraft. Again, because of photocropping it is most difficult to determine if this is an antenna and if so what is its length. Judging by its diameter, one could guess it to be quite short. Its diameter appears to be about one third that of the 2 meter turnstile elements. Could this be a 70 cm monopole? If so, what do you suppose it's used for? Maybe we'll have some answers to these questions later this Spring!

In the cover story itself we learn a few interesting new facts. We learn from a review of the history of the Radio Sputniks that the first RSs (1 and 2) resulted from the idea of a group from *RADIO* magazine in 1975. Control stations were established at the DOSAAF/USSR Space Technology Laboratory and the Moscow Aviation Institute. RS-1 and RS-2 used unpressurized components. (It is likely that one or more of the new birds IS sealed and pressurized since it has been learned that telemetry channel U in the first group reports a gas pressure.) It is proudly reported that with RS-1 G3IOR was able to work the command station in Moscow (RS-3A?) with only 30 to 50 mW. The results of the RS-1 and RS-2 experiments led directly to this new class of satellites called RS-3 through 8. It is significant that the article uses the terms "a continously operating system of...satellites" to describe the new birds. This seems to confirm the intent that when sufficiently dispersed, they should provide "continous" coverage (whatever that means!).

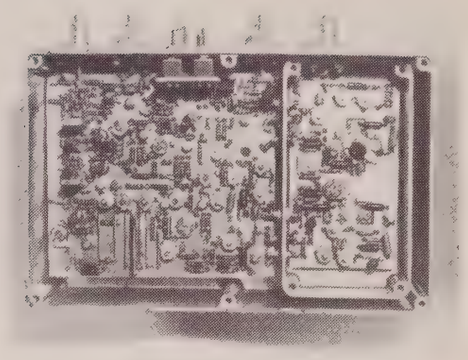
The article goes on to rate the capacity of each new RADIO Sputnik at "20 duplex telephone channels" (at 2.5 kHz each that's reasonable) or "80 telegraph channels" (that's 625 Hz each; generous). Extensive use of integrated circuits is reported. The robut is prominently placed in the article and throughly explained. A 100 character circular announcement feature or bulletin board is explained. The article explains the overall operation of the transponder including the robot, command decoder and transponder proper. The command repertoire is at least 56 commands and there is apparently some on-board autonomy in the event the spacecraft gets into trouble while out of range of the command station. This is apparent in the use of phrases like "a broad program" referring to the on-board command complex. There is a possibility that parameters such as temperature and pressure can be adjusted under ground command though the article does not state this explicitly. The power system consists of chemical batteries and solar cells. The control of the telemetry output is highly flexible and completely under ground control allowing the telemetry to be specifically tailored for routine scientific purposes as well as for spacecraft contingencies. For example, to learn the spin rate and orientation, the article suggests that the solar cell array current could be continously monitored. Finally, the article closes with the assurance that the new birds are "destined for a longer period of operation than were the first educational satellites of 1978."

One wonders if the authors were referring to AMSAT OSCAR 8 which continues to work flawlessly or to the RS-1/2 duet which fell from grace after but a few months of operation. In reviewing this article for *ASR* one is struck at once by the fact that only once is OSCAR mentioned. In explaining how wonderful were RS-1/2, it is noted that the "RADIO satellites were" more efficient "than those of the analagous satellites of the OSCAR series."

Inside front cover

Product Highlight File

The Microwave Modules MMT-435/28S



By Vern Riportella, WA2LQQ

The romance of exploring higher frequencies rapidly changes to hard reality when one realizes that the availability of off-the-shelf equipment for 23 cm and above is limited. Fortunately, the paths blazed by a few hardy souls are by now well trodden and one needn't search too hard for a solution to the (nearly) age-old question: "What the heck am I going to do for a signal on the new L-transponder of Phase IIIB?"

The most practical way for an amateur to get on the 24-cm uplink to Phase IIIB is to use a transmit converter. It appears that several models will be available by mid-82. That leaves the other half of the problem for the L-transponder: the receiver. The most recent L-transponder frequency scheme calls for a downlink at 436.150 to 436.950 MHz. This segment was chosen to avoid interference with present or planned services in the 70 cm band. But it does create a bit of a problem in that this segment of the band is outside of the usually frequented portions of the band. Consequently not much equipment exists for its use.

At least a partial solution is at hand. Microwave Modules of Liverpool, England will be introducing shortly a new version of their popular MMT-432/28S transverter that will cover the new L-transponder downlink in the 436 MHz range. The new model (tentatively called the MMT-435/28S) will sacrifice coverage in the 434-436 segments in favor of the required 435-437 MHz range. This is a particularly astute modification since the resulting unit will thus provide transmit in the Phase IIIB Mode B uplink range of 435.025 - 435.175 MHz and the L-transponder downlink range at 436.150 -436.950 MHz. Obviously these folks have been doing their homework!

The modification to the present MMT is simple and can be easily performed by most with a soldering iron. The change amounts to replacing the existing 101.5 MHz crystal with one for 101.75 MHz. According to Spectrum International of Concord, Massachusetts, Microwave Modules' U.S. distributor, a mod-kit will quite likely be offered for employment by present owners of the MMT-432/28S models. No price was quoted for the crystal.

That the new MMT-435/28S will not differ in performance from the older model in any regard (except for the new band segment) we have been apprised by Spectrum International. They also indicate that a model with a i-f at 2 meters (the MMT-435/144S) will also be available but it is more expensive than the 28-MHz i-f unit. This is because the 144 i-f unit has an extra mixer to beat down to 28 MHz and then mix to 435. This extra stage is necessary to avoid the problem of having the transmit mixer operating at the third harmonic of the i-f.

The MMT-432/28 has been around for at least six years. It was reviewed in *QST* for September, 1977 (page 43). The S-suffix model appeared in June, 1978 and included a small modification to ease band switching. The mod involved the inclusion of two small toggle switches to the front panel to allow manual band switching. Prior to the installation of these two switches, band switching was accomplished by applying an appropriate potential to an input connector pin. That feature is retained in addition to the manual switches on the newer S-suffix model. The ability to band switch by merely applying a potential to a connector pin is very attractive since it allows one to remote switch the unit if, as is often very desirable, it is found possible to install the entire unit at the antenna array. This is desirable, naturally, to reduce the transmission line losses incurred at 70 cm and replace them with the more tolerable i-f losses at 28 MHz.

The reviewer purchased his MMT-432/28S in October of 1978 and has been satisfied without exception with the unit. The die-cast metal box and competent-appearing circuit board speak of a well-engineered unit. Certainly the reliability is spoken for with now nearly four years logged on the unit. The specifications speak equally well of this unit. The *QST* reviewer noted a spurious output on the antenna connector when the unit was put in the transmit mode but with no drive. He suggested that this might be do to an oscillation in the receiver preamplifier due to an impedance mismatch. The spur was measured at −46 dBm or 86 dB below the 10 watt output level. That level presents no real problem even if it were common to all units which has not been established. The test report supplied with this reviewer's unit specifies maximum spurious outputs more than 65 dB down (from 10 watts) or −25 dBm. It appears that in true British tradition the ratings provided are quite conservative indeed. Sustaining this notion is the added fact that the reviewer's unit will still deliver an honest 13 watts to a 50-ohm resistive load with 13.8 Vdc power input. An absolute maximun of 14.5 Vdc is specified and for lowest receive noise figure the power supply should be "cooled off" to perhaps 12.5 Vdc. Finally, though the unit's receiver is specified to have a noise figure less than 3 dB, 2.2 dB to 2.5 dB is the most often encountered range according to Spectrum International. Although a 2.5 or 3 dB noise figure is OK for some work on 70 cm, the reader may want to improve on that with a modern GaAs FET preamp. A good one will cool off your front end to about 35 degrees K or about 0.5 dB. That will let you hear Phase IIIB as well as anything you can buy for under a kilobuck!

For the record, the Microwave Modules specs are as follows:

Frequency:	432 - 434 MHz and 435 - 437 MHz (Planned for MMT-435/28S)
Input Frequency Range:	28 - 30 MHz
Power Requirements:	11 - 13.8 Vdc. 12.5 Vdc nominal; 2.1 amps max
Connectors:	4 50-ohm BNC; 1 5-pin DIN
Dimensions:	187 mm x 120 mm x 53 mm
Weight:	900 grams (2 lbs)
Transmitter:	
Modes:	ssb, fm, am, cw
Input Drive:	5 mW to 500 mW (for full 10 watts out)
Power Output:	10 watts (continuous)
Spurious outputs:	Less than −65 dB
Quiescent current:	250 mA
Receiver:	
Converter Gain:	30 dB typical
Overall Noise Figure:	3 dB maximum (289 degrees K)
Input/Output Impedance:	50-ohms
Quiescent current:	100 mA typical
Local Oscillator:	
Maximum drift:	±5 kHz at 432 MHz
Typical drift:	2 kHz/hr at 432 MHz
Frequency sensitivity:	50 Hz for power range 11.0 to 13.8 Vdc
Price Class:	Unnannounced but anticipated in $330 range.

AMSAT News

Organizational items of interest to all members of the Radio Amateur Satellite Corporation

Colonel John W. Browning
Space Division, Retires

The following U.S. Air Force news release is published to honor W6SP.

"The Department of the Air Force announces the retirement of Colonel John W. Browning, Deputy for Space Communication Systems, Space Division, Los Angeles Air Force Station, California. Colonel Browning was born in Wheeling, W.V. on May 18, 1924. At age 18, following graduation from Terra Alta High School, he enlisted as a Private in the U.S. Army Reserve and in February, 1943, was called to active duty. He entered pilot training as an aviation cadet and in 1944 received his wings and a commission as a Second Lieutenant in the Army Air Corp at Moody Field, Valdosta, Ga. His first assignment was a combat tour with the 98th Bomb Group in Italy as a B-24 pilot after which he returned to the States for training as a B-29 Commander. Upon cessation of hostilities, Colonel Browning was released from active duty and entered West Virginia University. In 1949 he received a Bachelor of Science Degree in Electrical Engineering and then worked as a maintenance engineer in private industry until May, 1952, when he was recalled to active duty with the Air Force. He served as an avionics maintenance officer with the 509th Bomb Wing in Roswell, N.M. followed by a tour with the 58th Fighter Bomber Group in Korea. From 1954 to 1957, Colonel Browning became combat ready in the F-86 while stationed at Yokota Air Force Base, Japan with the 40th Fighter Interceptor Squadron.

"The next three years were spent as a Flight Commander in the Air Force Basic Pilot Training Program at Webb Air Force Base, Texas. In 1960 Colonel Browning went to Purdue University under the Air Force Institute of Technology Program and in 1961 received a Masters Degree in Industrial Management. His follow-on assignment was to the Ballistic Systems Division at Norton Air Force Base, California until 1965. He then served with the Secretary of the Air Force Special Projects Office at Los Angeles Air Force Station, California prior to a three year tour with the Air Force Office of Space Systems in Germany. In 1974 he was chosen Commander of the Satellite Test Center at Sunnyvale, California and in 1977 became Vice Commander of the Air Force Satellite Control Facility. Returning to Los Angeles in 1978, Colonel Browning was assigned to Space and Missle Systems Organization, the forerunner of Space Division as Assistant Deputy for Space Communications Systems and Program Director for International Communications Satellites. He assumed his present position as Deputy for Space Communications Systems in 1979. In addition, he recently became the Program Director of the MILSTAR strategic and tactical communications satellite system. His retirement today culminates a distinguished career spanning 32 years of active duty and 39 years of total military service to his country.

"Colonel Browning is a command pilot with over 3200 hours flying time and 40 combat missions to his credit. He has been awarded the Distinguished Service Medal, Legion of Merit with one oak leaf cluster, Distinguished Flying Cross, Meritorious Service Medal, Air Medal with two oak leaf clusters, Air Force Commendation Medal with one oak leaf cluster, the Purple Heart and he wears the Master Missleman Badge."

The Distinguished Service Medal is the highest peacetime medal awarded in the U.S. Colonel Browning's award is a singular honor. The citation accompanying the Medal reads in part as follows:

"Through his superb management and forceful leadership in this important position "(Deputy for Space Communications Systems)" he contributed immeasureably to the establishment of superior satellite communication systems to support the global operations of the United States and North Atlantic Treaty Organization military forces. His technological foresight, initiative and personal dedication have charted the course for development of satellite communication systems through the next decade.

"The singularly distinctive accomplishments of Colonel Browning culminate a long and distinguished career in the service of his country and reflect the highest credit upon himself and the United States Air Force."

John adds with tongue firmly planted in cheek that along with Admiral Rickover, he just couldn't figure out to stay on any longer.

"Brazil's AMSAT Area Coordinator Edmilson R Do O', PY7CPK; an active OSCAR DXer. Ed has greatly stimulated OSCAR interest in Brazil through his articles in the Brazilian magazine, *Electronica Popular*."

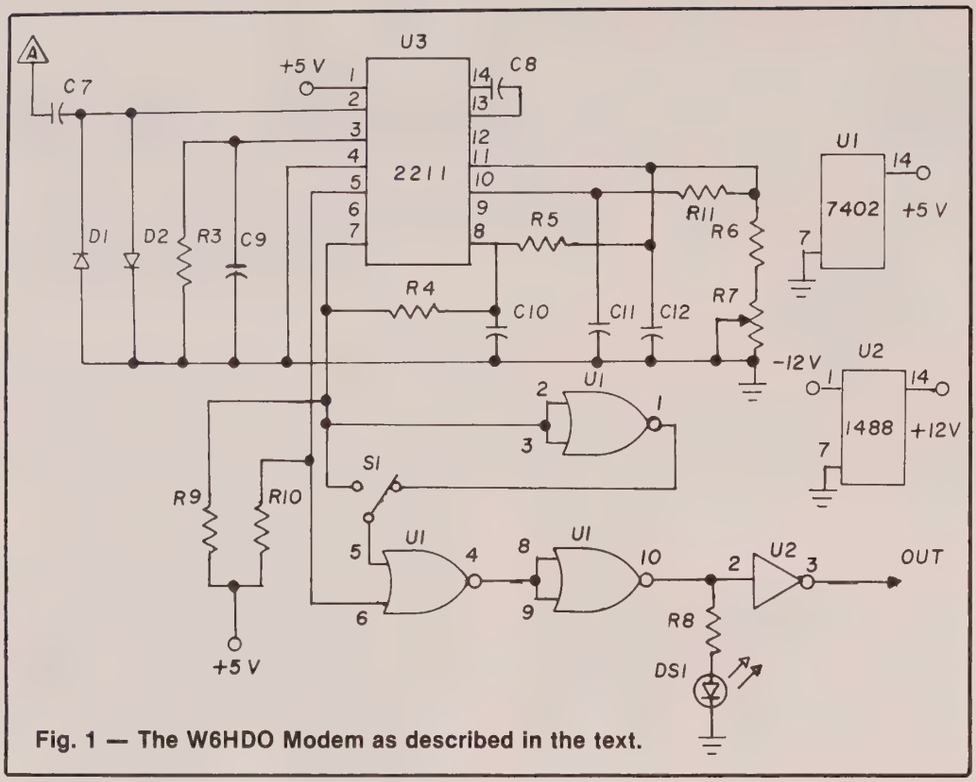


Fig. 1 — The W6HDO Modem as described in the text.

Simple UoSAT-OSCAR 9 Demodulator

UoSAT-OSCAR 9 is up but many have not had the opportunity to decode the telemetry on 145.825 MHz. The 300 baud signals were easily decoded but the 1200 baud signals require a bit more equipment.

W6HDO needed a demodulator for both 300 and 1200 baud. The drawing shows the result. The 2211 made by both Exar and Raytheon is a tri-state FSK modem chip and can be used for both the 300 and 1200 baud telemetry if appropriate external components are carefully selected.

An input filter composed of two 88mHy loading coils connects the modem to the receiver. These are resonated at 2400 Hz and then overcoupled so that two separate response curve peaks coincide with the tones used for the UoSAT FSK: 2400 and 1200 Hz.

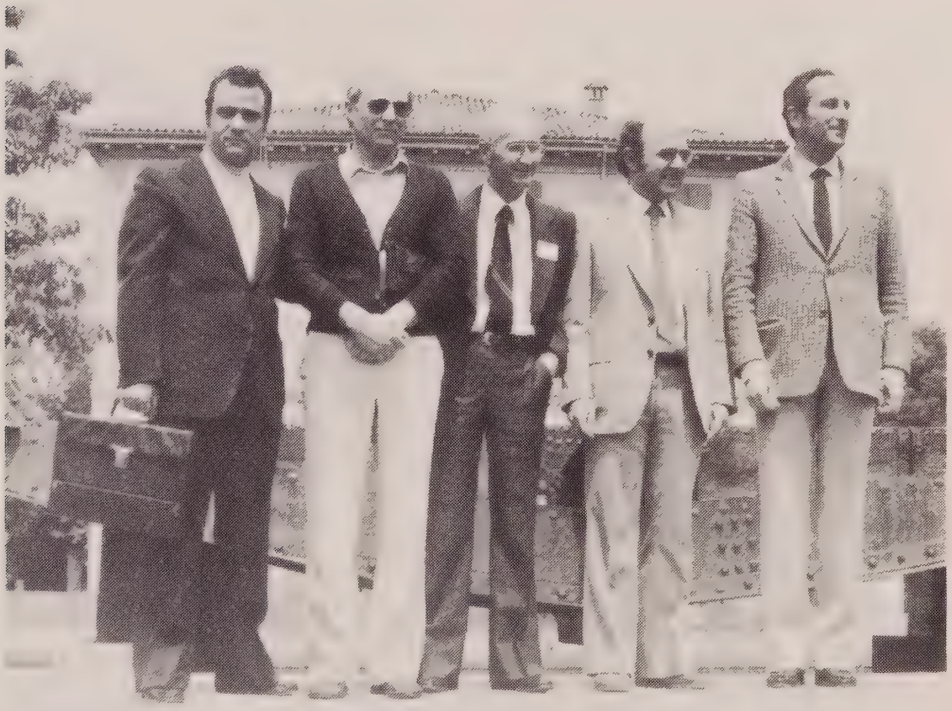
The constants were calculated from the Exar application note and were optimized for 1200 baud. The carrier detect feature is used as a "Mark-Hold" device. A 7402 TTL NOR gate is employed to invert the data sense when using the modem at 300 baud. The circuit includes a 1488 level converter chip for those applications requiring RS-232C signal levels.

If your application requires only TTL levels, then eliminate the 1488 and take your output directly from the 7402. Be certain to use only polycarbonate or mylar capacitors for the VCO capacitor (0.027 Mf) to assure a stable VCO frequency with changing temperatures. The other caps need only be good quality units. An optional grounding switch can be included to ground pin 5 of the 2211 if the signal is fading; it disables mark-hold. The filter should be placed in series with the speaker. The rig will operate normally for voice frequencies and extracts only the 1200 and 2400 Hz tones used on the FSK telemetry.

Parts List
(Numbers in parentheses refer to Radio Shack catalog numbers)

T1, T2—88mHy torroids with 30 turns of 18 or 20 AWG insulated.
R1, R2—22k (271-1339)
R3—330k
R4, R5—10k (271-1335)
R6—510k
R7—Any stable resistor between 33-36k
R8—100k (271-1347)
R9—1k (271-1321)
R10—15k (271-1337)
R11—10k (ten-turn precision pot preferred)
C1, C3—.047 (272-1068)
C2, C4, C6—.01 (272-1065)
C5—.068
C7, C9, C13—.1 (272-1415)
C8—.027 poly or mylar
C10—.47 mylar (272-1054)
C11—.0025 poly*
C12—.0011 poly*
Z1—Exar (Raytheon) 2211
Z2—7402 (276-1811)
Z3—1488
D1, D2—1N4001 (or 276-1122)
D3—LED (276-041)
S1—switch (275-407)

*These can be comprised of two or more paralleled units.



Participants in a meeting in Italy last Spring. Standing in front of the house of Marconi in Pontecchio Marconi Villa Grifone are (l to r): IT9ZDA, I3IVP, I8CVS, DJ4ZC, I5TDJ. The occasion was the AMSAT-ITALY Third National Congress where DJ4ZC was a special guest and spoke about Phase III plans.

New Project OSCAR Calendars

Project OSCAR will be bringing out a new version of its famous amateur satellite orbit prediction calendar soon. The new version will be the largest ever and provide orbit details on AO-8 as well as all the new RS birds (3-8). According to Project OSCAR officials the new calendar will be available shortly. Monitor *ASR* and the AMSAT Nets for announcements regarding price and availability of the calendar.

AMSAT Stickers Slated For Spring

Beginning in early April AMSAT will be offering distinctive bumper stickers in exchange for a small donation. The colorful stickers will show the Phase IIIB bird in its new regalia including the brand new antenna configuration for the L transponder as well as the Mode B transponder. The stickers will be suitable to adhere to attache cases, shack walls, and virtually any place you wish. The price and availability will be announced at a later date.

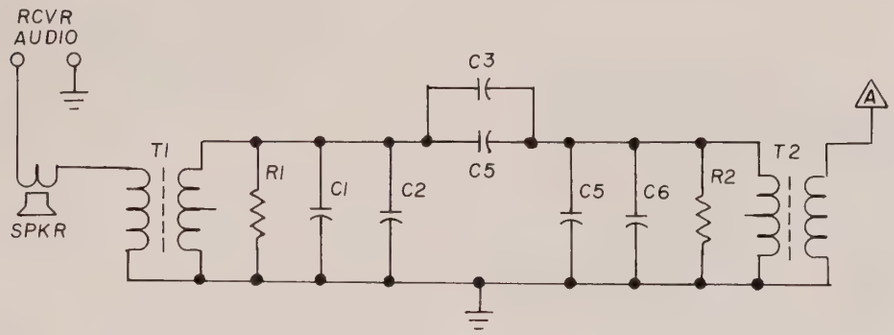


Fig. 2 — Circuit diagram for the W6HDO filter. See text for details.

Intel IC Donation Eases Phase III Costs

One of the largest integrated circuit houses in the world, Intel, of Sunnyvale, California recently made a major donation of ICs to AMSAT for use with the Phase III satellite ground command stations. The type 2141L static RAMs (Random Access Memories) were accepted on behalf of AMSAT by John Fail, KL7GRF/6 at Intel's Tarzana, California office 29 Jan. The donation of 400 of these RAMs is valued at nearly $4000! The 4K X 1 static RAMs are extraordinary in that they feature 120 nano second access times and consume far less power than similar devices.

Carl Stevenson, WA6VSE, was instrumental in developing the gift to AMSAT. Carl, who is Managing and Technical Editor of Communications Magazine, established contact with Intel on AMSAT's behalf and managed the negotiations.

On behalf of its 5,000 members around the world, AMSAT expresses its sincere appreciation to the Intel Corporation for its generosity and simultaneously extends thanks to WA6VSE and KL7GRF for their productive efforts. The incorporation of this valued hardware into the ground control system goes a long way to assuring the timely integration of the stations required for successful operation of the new Phase IIIB satellite this summer.

K8OCL Demonstrates 6-dB $ Amplifier

John J. Champa, K8OCL, AMSAT's Northeastern Ohio Area Coordinator, recently demonstrated an effective money amplifier for AMSAT's benefit. Here's how it worked.

John donated $100 to the 20th Anniversary Amateur Satellite Fund Drive through his employer's matching fund plan. John's employer (Cooper Industries of Houston, TX) then took John's donation and matched it with another $100. Thus the Satellite Fund Drive, administered by the ARRL Foundation, received a check from Cooper Industries for $200. The ARRL Foundation matching funds then matched that $200 to yield $400 for the benefit of the Amateur Space Program. So John's original $100 has been converted to a $400 input to build satellites. In the financial world John's actions would be viewed as an astute use of leverage. That is, he was able to leverage a large block of dollars with a relatively small investment. In the electronics domain they call that "gain." The gain of John's dollar amplifier is easily seen as 6 dB according to the equation: gain in dB = 10 log O/I where O is the output and I is the input. (We use the power rule instead of the voltage gain, i.e., 20 log O/I, since everyone knows money is power!) Which ever way you look at it, though, John's input is appreciated. The output is appreciated about 6 dB $ more! John suggests that others look to their employers to learn if they have an analagous matching fund program. It may prove to be an important source of revenues for AMSAT in the future.

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Satellite Log

*By Geoffrey Falworth**

Satellite Log features launches into orbit since the beginning of 1980. The satellite name is that assigned by the launching agency (the international designation is in parenthesis) and the orbit (period, inclination to Earth's equator, apogee height, perigee height) is for shortly after launch; later maneuvers may modify this orbit. Transmissions are those which are publicly reported or assumed from the type of spacecraft involved.

Rohini Satellite 3 (1981-51A) launched on 1981 May 31; initial orbit: 90.48 min, 46°.27, 418 km, 186 km; transmissions: 137.420 MHz. Indian test satellite.

Cosmos 1274 (1981-52A) launched on 1981 Jun 3; initial orbit: 88.90 min, 67°.19, 294 km, 147 km; transmissions: none reported. Recoverable reconnaissance satellite.

Cosmos 1275 (1981-53A) launched on 1981 Jun 4; initial orbit: 104.91 min, 82°.96, 1014 km, 964 km; transmissions: 150.000 MHz. Navigation satellite.

Molniya 83 (1981-54A) launched on 1981 Jun 9; initial orbit: 717.93 min, 62°.77, 39924 km, 442 km; transmissions: 3650 to 3700 MHz, 3750 to 3800 MHz, 3850 to 3900 MHz. Molniya 3-class communications satellite.

Cosmos 1276 (1981-55A) launched on 1981 Jun 16; initial orbit: 89.07 min, 82°.37, 239 km, 216 km; transmissions: none reported. Recoverable reconnaissance satellite.

Cosmos 1277 (1981-56A) launched on 1981 Jun 16; initial orbit: 89.07 min, 82°.37, 239 km, 216 km; transmissions: none reported. Recoverable reconnaissance satellite.

Meteosat 2 (1981-57A) launched on 1981 Jun 19; initial orbit: 1436.20 min, 0°.97, 35798 km, 35786 km; transmissions: 137.080 MHz, 468.875 MHz, 468.925 MHz, 1675.281 MHz, 1675.929 MHz, 1686.833 MHz, 1691.000 MHz and* 1694.500 MHz. European meteorological satellite over longitude 0°.50 West.

Apple 1 (1981-57B) launched on 1981 Jun 19; initial orbit: 1436.11 min, 0°.08, 35795 km, 35785 km; transmissions: 137.192 MHz, 4095.000 MHz and 4140 to 4180 MHz. Indian communications satellite over longitude 105°.49 East.

Cat 3 (1981-57C) launched on 1981 Jun 19; initial orbit: 632.12 min, 10°.45, 35838 km, 202 km; transmissions: 136.610 MHz. Capsule Ariane Technologique launch vehicle monitoring payload.

Cosmos 1278 (1981-58A) launched on 1981 Jun 19; initial orbit: 727.40 min, 62°.84, 40217 km, 615 km; transmissions: 2292 MHz. Early warning satellite.

Noaa 7A (1981-59A) launched on 1981 Jun 23; initial orbit: 102.04 min, 98°.90, 862 km, 844 km; transmissions: 136.770 MHz, 137.500 MHz, 137.620 MHz, 137.770 MHz, 1698.000 MHz, 1702.500 MHz, 1707.000 MHz. Weather satellite.

Molniya 84 (1981-60A) launched on 1981 Jun 24; initial orbit: 736.16 min, 62°.77, 40630 km, 632 km; transmissions: 800 to 1000 MHz, 3400 to 4100 MHz. Molniya 1-class communications satellite.

Ekran 7 (1981-61A) launched on 1981 Jun 26; initial orbit: 1436.16 min, 0°.02, 35824 km, 35758 km; transmissions: 702 to 726 MHz, 714.000 MHz. Television relay satellite at Statsionar T location over 99° East.

Cosmos 1279 (1981-62A) launched on 1981 Jul 1; initial orbit: 90.30 min, 70°.42, 368 km, 210 km; transmissions: none reported. Recoverable reconnaissance satellite.

Cosmos 1280 (1981-63A) launched on 1981 Jul 2; initial orbit: 89.50 min, 82°.31, 285 km, 212 km; transmissions: none reported. Recoverable reconnaissance satellite.

Cosmos 1281 (1981-64A) launched on 1981 Jul 7; initial orbit: 90.44 min, 72°.84, 394 km, 198 km; transmissions: none reported. Recoverable reconnaissance satellite.

Meteor 38 (1981-65A) launched on 1981 Jul 10; initial orbit: 97.56 min, 97°.94, 671 km, 610 km; transmissions: 137.150 MHz. Weather satellite.

Iskra 1 (1981-65C) launched on 1981 Jul 10; initial orbit: 97.76 min, 97°.98, 663 km, 638 km; transmissions: 5100 MHz. Moscow Aviation Institute aeronatical communications test satellite.

Cosmos 1282 (1981-66A) launched on 1981 Jul 15; initial orbit: 89.51 min, 64°.90, 335 km, 173 km; transmissions: none reported. Recoverable reconnaissance satellite.

Cosmos 1283 (1981-67A) launched on 1981 Jul 17; initial orbit: 88.97 min, 82°.31, 262 km, 182 km; transmissions: none reported. Recoverable reconnaissance satellite.

Cosmos 1284 (1981-68A) launched on 1981 Jul 29; initial orbit: 88.79 min, 82°.32, 242 km, 183 km; transmissions: none reported. Recoverable reconnaissance satellite.

Raduga 9 (1981-69A) launched on 1981 Jul 30; initial orbit: 1436.32 min, 0°.38, 35855 km, 35734 km; transmissions: 3675 MHz, 3775 MHz, 3875 MHz, 7250 to 7750 MHz. Communications satellite at Statsionar 2 location over longitude 35° East.

Dynamics Explorer 1 (1981-70A) launched on 1981 Aug 3; initial orbit: 409.34 min, 89°.91, 23073 km, 314 km; transmissions: none reported. Upper atmosphere and magnetosphere research satellite.

Dynamics Explorer 2 (1981-70B) launched on 1981 Aug 3; initial orbit: 97.83 min, 89°.99, 1002 km, 303 km; transmissions: none reported. Upper atmosphere and magnetosphere research satellite.

Cosmos 1285 (1981-71A) launched on 1981 Aug 3; initial orbit: 727.19 min, 62°.92, 40238 km, 533 km; transmissions: 2292 MHz. Early warning satellite.

Cosmos 1286 (1981-72A) launched on 1981 Aug 4; initial orbit: 93.33 min, 65°.04, 445 km, 432 km; transmissions: none reported. Ocean radar reconnaissance satellite.

Fleetsatcom 5 (1981-73A) launched on 1981 Aug 6; initial orbit: 1558.18 min, 6°.33, 41185 km, 35102 km; transmissions: 244 to 270 MHz, 2252.500 MHz, 2262.200 MHz. Communications satellite leased to US Navy to be located over longitude 100° West.

Cosmos 1287 (1981-74A) launched on 1981 Aug 6; initial orbit: 115.79 min, 74°.03, 1515 km, 1466 km; transmissions: none reported. Military communications satellite.

Cosmos 1288 (1981-74B) launched on 1981 Aug 6; initial orbit: 115.58 min, 74°.03, 1494 km, 1468 km; transmissions: none reported. Military communications satellite.

Cosmos 1289 (1981-74C) launched on 1981 Aug 6; initial orbit: 115.36 min, 74°.02, 1481 km, 1462 km; transmissions: none reported. Military communications satellite.

Cosmos 1290 (1981-74D) launched on 1981 Aug 6; initial orbit: 115.18 min, 74°.03, 1466 km, 1460 km; transmissions: none reported. Military communications satellite.

Cosmos 1291 (1981-74E) launched on 1981 Aug 6; initial orbit: 115.18 min, 74°.03, 1466 km, 1460 km; transmissions: none reported. Military communications satellite.

Cosmos 1292 (1981-74F) launched on 1981 Aug 6; initial orbit: 114.83 min, 74°.03, 1466 km, 1428 km; transmissions: none reported. Military communications satellite.

Cosmos 1293 (1981-74G) launched on 1981 Aug 6; initial orbit: 114.65 min, 74°.03, 1467 km, 1411 km; transmissions: none reported. Military communications satellite.

**12 Barn Croft, Penwortham, Preston, PR 10 SX, England*

Cosmos 1294 (1981-74H) launched on 1981 Aug 6; initial orbit: 114.46 min, 74°.04, 1466 km, 1395 km; transmissions: none reported. Military communications satellite.

Intercosmos 22 (1981-75A) launched on 1981 Aug 7; initial orbit: 101.98 min, 81°.22, 898 km, 804 km; transmissions: 20.004 and 40.008 MHz. Laser reflector-carrying Intercosmos research satellite with Bulgarian experiments.

Geostationary Meteorological Satellite 2 (1981-76A) launched on 1981 Aug 10; initial orbit: 1435.98 min, 1°.21, 35792 km, 35776 km; transmissions: 136.890, 468.900, 1681.600, 1684.000, 1687.100, 1688.200, 1690.200, 1691.000, 1694.000, 1694.300 and 2286.500 MHz. Japanese weather satellite over longitude 160°.63 East.

Cosmos 1295 (1981-77A) launched on 1981 Aug 12; initial orbit: 104.77 min, 82°.93, 1017 km, 908 km; transmissions: 150.000 MHz. Navigation satellite.

Cosmos 1296 (1981-78A) launched on 1981 Aug 13; initial orbit: 89.79 min, 67°.42, 358 km, 170 km; transmissions: none reported. Recoverable reconnaissance satellite.

Cosmos 1297 (1981-79A) launched on 1981 Aug 18; initial orbit: 90.15 min, 72°.87, 364 km, 191 km; transmissions: none reported. Recoverable reconnaissance satellite.

Cosmos 1298 (1981-80A) launched on 1981 Aug 21; initial orbit: 89.55 min, 64°.90, 331 km, 174 km; transmissions: none reported. Recoverable reconnaissance satellite.

Cosmos 1299 (1981-81A) launched on 1981 Aug 24; initial orbit: 89.66 min, 64°.99, 265 km, 252 km; transmissions: 166 MHz. Nuclear-powered ocean reconnaissance satellite.

Cosmos 1300 (1981-82A) launched on 1981 Aug 24; initial orbit: 97.79 min, 82°.50, 666 km, 638 km; transmissions: none reported. Electronic surveillance satellite.

Cosmos 1301 (1981-83A) launched on 1981 Aug 27; initial orbit: 89.33 min, 82°.31, 263 km, 217 km; transmissions: none reported. Earth-resources, recoverable reconnaissance satellite.

Cosmos 1302 (1981-84A) launched on 1981 Aug 28; initial orbit: 100.81 min, 74°.03, 811 km, 783 km; transmissions: none reported. Data relay satellite.

Satellite News: The news bulletin of satellites, spacecraft and space activity is available in four editions: *Space Objects Digest, Military Space Digest, Space Operations Review* and *Space Systems Digest.* The price is 25 cents per issue: subscribe for as many issues as you like. Payments and orders by International Money Order, cash or check. Please add $2 to personal checks for UK bank charges. Orders should be sent to: Geoffrey Falworth, 12 Barn Croft, Penwortham, Preston PR 10 SX, England.

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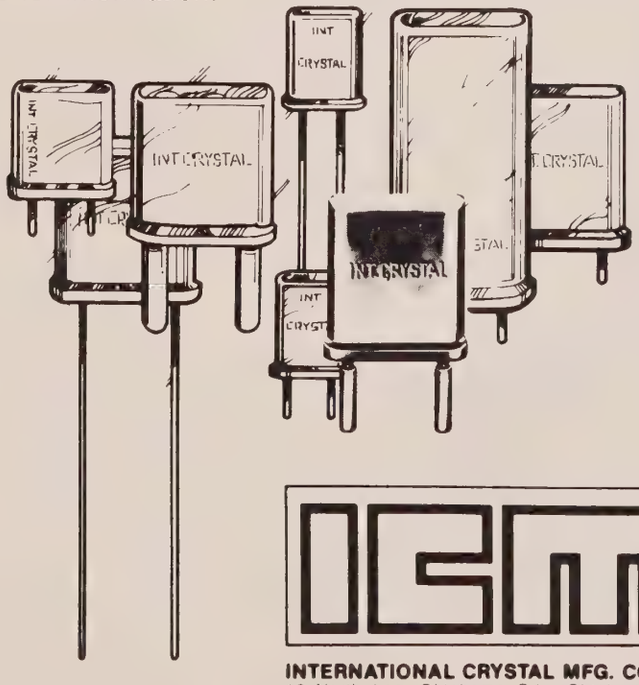

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G3IOR

Worldwide Satellite Activity

By Pat Gowen, G3IOR*

The end of 1981 was certainly an epic in the annals of amateur radio!

The new bands commenced their amateur use, hf propagation was superb, 80 and 160 meters gave excellent DX paths, and 50 MHz produced regular and incredibly good openings. Such was the remarkable state of the solar cycle, that even the British 4 meter (70 MHz) band opened via the F_2 layer, to give the first Europe to North America crossband contacts.

Perhaps the satellite enthusiasts benefitted most of all, as UoSAT OSCAR went into a perfect circular nominal orbit, AMSAT-OSCAR 8 came out of its "hot spell" with flying colors, thanks to the skill of its capable command stations, and news of the early July 1982 launch of AMSAT Phase IIIB was confirmed.

Perhaps the best news of all was the successful long awaited launch of the new 'RS' series of 'Radio' satellites by our colleagues in the Soviet Union. To compensate for our patient wait, six excellent satellites were placed into idealized orbits by a special launch on 17 December.

Rich, K1HTV, and your author, could hardly contain our delight when we found the Mode A downlink band full of beacons at 1230 UTC soon after their release. Within a few days, all the transponders and "Robots" were activated, giving the renewed opportunity of chasing satellite DXCC to many who had been forced to put the activity into temporary cold storage. Within the week, Bob, G6RH reported a new country active and worked, VI3, UD6DFD, while Dave, G4CUO 'phoned me to celebrate his 100th DXCC country worked—424! On the other side of the Atlantic, those within grasping distance of their WAS-Satellite were similarly rewarded, with K1HTV/3, son Andy, KA1GD/3, and W3IWI, Tom, all working WH6AMX and KH6IBA for that ultra-DX 50th state. George, VE2LI has heard them but not worked so far.

A prolific number of new sections are up and active in Europe, but with only one African (EA8CS) yet heard. No activity has been heard from here from South America, but Benny, HC1BI was among the callsigns being listed by the RS5 and 7 "Robot" on its playback of stations worked, with quite a few more rare ones.

Asia is now well represented, and several calls are listed in our DX list this issue which may well be workable from North America.

Latest information to hand on the 'RS' Radio Satellites of the Soviet Union. Information is based on findings, and any assumed presumption is omitted. The drag factor is not included, and is relatively insignificant at this height. Further information will be given out on the AMSAT nets as it comes to hand verified.

Satellite	RS3	RS4	RS5	RS6	RS7	RS8
Period	118.46293 min.	119.33912 min.	119.49842 min.	118.66154 min.	119.14014 min.	119.70890 min.
Increment	29.756498°	29.97578°	30.01562°	29.80622°	29.92596°W	30.06830°
Inclination	82.9592°	82.9603°	82.9629°	82.9542°	82.9629°	82.9570°
Apogee	1688 km	1691.5 km	1689.9 km	1690.5 km	1688.9 km	1693.4 km
Perigee	1577.4 km	1640.5 km	1653.2 km	1592.5 km	1634.2 km	1657.1 km
Reference Orbit	0105.50	0043.23	0143.59	0023.17	0126.59	0104.18
For 18 Jan. 82	231.9°W	225.9°	241.9°	221.2°	237.1°	231.1°
Robot Uplink (1)	Nil ? (2)	Nil (CA)	145.826 MHz	Nil (CA)	145.835 MHz	Nil (CA)
Robot Downlink (1)	Nil ? (2)	Nil (CA)	29.331 MHz	Nil (CA)	29.341 MHz	Nil (CA)
TLM Beacons	29.321 MHz	29.360 MHz	29.331 MHz	29.411 MHz	29.341 MHz	29.461 MHz
(or Robot use) (1)	29.401 MHz	29.408 MHz	29.452 MHz	29.453 MHz	29.501 MHz	29.502 MHz
Transponder Up	? (CA)	Thought to be on 29.400-29.300	145.910-950	145.910-950	145.960-146.000	145.960-146.000
Transponder Down	? (CA)	145.860-900 (CA)	29.410-450	29.410-450	29.460-500	29.460-500
Daily time change on following days	−18.44484 min. per day	−7.93056 min. per day	−6.01895 min. per day	−16.06152 min. per day	−10.31832 min. per day	−3.4932 min. per day
Eq. orbit Change of Long. °W on following day	−2.922084° per day	−0.29064° per day	+0.18744° per day	−2.32536° per day	−0.88848° per day	+0.8196°W per day
Employment Use	For Experiments only-QRO Beacon	Experimental Research only	Amateur use	Amateur use	Amateur use	Amateur use
Employment Time	For Experiments only-QRO Beacon	Experimental Research only	Any time but not Wednesdays	Any time but not Wednesdays	Any time but not Wednesdays	Any time but not Wednesdays

(1) All frequencies are basic, and doppler is addative or subtractive.
(2) If 'Robot' is on RS-3, not yet heard, it will be 145.820-29.320 MHz.
(CA) Confirmation awaited.
Schedule: Wednesdays are for Scientific use only such as research and experiments. No use of transponding or usual QSO's may be made on this day.
Uplink Power requirements: The 'RS' satellites are extremely sensitive, with an adequate downlink. 5 watts erp will provide a good return, even with the 10-dB attenuator inserted, on the proviso that other stations are not exceeding the limits. Under no circumstances should more than 50 W erp be exceeded, or you will cause weaker and rarer stations to be attenuated. If you cannot hear 5 W erp returned, attend to your receiver, or advise those who are running excess.

*17 Heath Crescent, Hellesdon, Norwich, Norfolk, NR 66 ND, England

Some of the "rare" stations now operating the RS Satellites

Call	Usual Frequency/Mode	Times Heard	Notes
VP9IB	29.420/470 RS6 & 8 cw	2300	First VP9 on RS
OX3WS	29.940 RS6 ssb	22-2330	Good signal from Greenland
HG1ZA	29.415/465 RS6/8 cw	1400-2000	Good signal from Hungary
HG7PR	29.415/465 RS6/8 cw	1400-2000	Good signal from Hungary
HG6VV	29.415/465 RS6/8 cw	1400-2000	Good signal from Hungary
HG2RD	Low end cw	1500-2100	Good signal from Hungary
HG1TJ	Low end cw	1500-2100	Good signal from Hungary
OK3AU	Mainly cw but ssb too	most orbits	Consistant operator
OK3BMW	cw on low ends	Every day	
UP2BJD	29.425 RS6 cw	1600-2100	
UP2CG	29.420 RS6 cw	1600-2100	
UR2JL	29.420 RS6 cw	1500-2100	Rather rough T-7 note
UD6DFD	29.425/475 RS6/8 cw	Many passes	All time new selective country
UA1CNA	29.420/470 RS6/8 cw	Every orbit	T-8 chirpy note
UA1NRA	RS8 low end cw	Occasional user	
UB5VAJ	Mid band ssb	1630-2000	
UB5MGW	RS6 & 8 cw & ssb	On most orbits	Good signal
UL7DD	RS6 & 8 cw	Regularly active	Good signal
RA9UBZ	RS6 & 8 cw	High angle elevations	
RA9FBZ	RS6 & 8 mainly cw	Regularly active	Good signal
UA9FAD	RS6 & 8 cw	All orbits in range	Excellent signal
UA9FDZ	RS6 & 8 cw/ssb	All orbits in range	Excellent signal
UA9CKW	RS8 ssb	1400-1800	Very strong, Rx not so good
UK9SAD	RS8 ssb	1000-1800	Very strong, great Rx too
UT5BN	RS6 & 8 cw mid band	1800-2000 UTC	Regular operator
UK1AAA	Mainly RS6/8	morning UTC passes	Good signal & Rx
UW4NI	RS6 & 8 cw	Most passes	YL operator
LZ1AB	RS6 & 8 low end cw	Most orbits	
LZ2KBI	RS6 & 8 low end cw	Most orbits	
YU3BA	RS6 & 8 mid band cw	Most orbits	
YU3OV	RS6 & 8 mid band cw	Most orbits	
UA3TOO	RS6 cw	1700-1900	Rather weak, but good Rx
UK3ACM	RS6 & 8 mainly cw	Most passes	Moscow University station
RS3A	RS6/8 cw & ssb	Many orbits	Command for RS Satellites
UA3CR	RS6/8 cw	Evening orbits	Look for Leo/UAØ in Spring DXpedition to N. Pole
UA3CR	RS6/8 cw	Evening orbits	
RA3AGS	RS6/8 cw & ssb	Afternoon & evening	
UA3EG	RS6/8 cw & ssb	Afternoon & evening	
YO2IS	RS6/8 cw	1700-1900	QRV again
UL7GBD	RS6/8 cw	Most passes in range	Good fast cw operator
CT1WW	RS8 ssb	1800-2100	QRV again
EA8CS	RS6 & 8 cw	1800-2230	Usually 8 wpm cw
EI6AS	RS6 & 8 ssb & cw	Most orbits	
EI4CL	RS6 & 8 ssb & cw	Most orbits	

Even with the 10 dB attenuator pads in, the satellites are very sensitive, and my hand-held TR2400 with rubber-duck antenna provided a RST 519 return. On one mid-day UTC pass the attenuator, indicated by the RS-8 telemetry, was commanded out, just as the satellite left my horizon. By running kw erp I could get enough scatter off the F_2 for a RST 31A downlink when RS-8 was 7 minutes past LOS!

The dynamic range of the RS series seems well down on AMSAT-OSCAR 8's and the ALC much faster.

Major problems are evidenced in daylight passes by the ever increasing number of stations, mainly fm, transmitting in the Mode A downlink pasband, as well as the severe attenuation due to dense ionization, when often the downlink is better heard non line-of-sight. A further problem, particularly in Europe, are the number of fm stations transmitting in the Mode A uplink (and current AMSAT-OSCAR 9, plus future Phase IIIB downlink) band. While RS-7's "Robot" is sometimes usable, the RS-5 "Robot" is blocked for 95% f all passes due to the continued transmissions of both repeaters and simplex stations in its passband.

OSCAR-8 continues to carry its regular traffic, and Mode J is by far the best mode in daylight hours. Since the last report, GM4IMJ and W4AUZ have made several more QSO's and GI8MXY has also worked W4AUZ, who is looking now for a G QSO and deeper into Europe. John, GM4IMJ, similarly is looking deeper into Canada and the U.S.

With so many satellites now potentially available, we hope that users will let us know their activities and stations worked to publish in the next issue of *ORBIT*.

Did You Renew Your Membership?

Your support is needed to continue the work on Phase IIIB now being completed by your technical team. Please send your dues today!

Around the World

By Kaz J. Deskur, K2ZRO*

Scanning the international amateur journals of the last few months, I had difficulty in finding any articles of topical interest to OSCAR users that was not a rehash of previously published material (which, I noticed, is a popular practice). Reviewing various amateur publications one may conclude, however, that hams around the world are well informed and are up to date on the subject of amateur space involvement, operating practices, and AMSAT activities. Most major amateur magazines maintain an AMSAT/SPACE section that publishes AMSAT's press releases, describes local involvement and activities, provides orbital predictions and occasionally, abstracts or reprints of more interesting material related to space communications.

Operating via Phase II satellites is now "old hat;" consequently, not much of real interest shows up in recent publications.

UoSAT is relatively new (and at this writing, not yet fully operational) therefore, virtually no "unofficial" material was printed on this subject anywhere so far.

One may expect however, that launching of Phase III satellite, and full activation of UoSAT, will bring an abundance of topical articles in international amateur publications. We, of course, will review them and keep you informed.

Articles on the subject of tracking OSCAR satellites appeared in at least two major professional journals. October 1981 issue of *Electronics* (USA) contained a TI-59 program written by Janos Molnar (Hungary). This program solves 29 interrelated orbital equations of elliptical by orbiting satellites. Phase III spacecraft is mentioned as a typical example for the application of the program.

The prestigious British *Wireless World* of August and September 1981 had a paper by Neoklis Kyriasis, 5B4AZ, describing a program for tracking circularly orbiting OSCAR satellites. The program is written for the *Wireless World* scientific computer (relatively little known outside U.K.) that processes orbital parameters and converts the data, for use with appropriate interface, to control the azimuth and elevation of the tracking antenna. The author describes in detail the computer-antenna interface circuit. The rotator used is alliance U-200 "Tenna Rotor."

At the first glance, the popular Kenwood TR-9000 multimode, compact 2-m transceiver appears to be perfectly suited for either base or mobile OSCAR operation. Unfortunately it has one serious drawback; namely, its frequency cannot be changed while the rig is in the transmitting mode. This handicap makes finding ones own downlink, or tuning on a desired station, outright discouraging and frustrating. Bill Cooley, WB2YIK, figured out the way to overcome this problem through only a very minor modification. It requires inserting a SPST switch in the line labeled T9 that connects the transmitter to the X53-1160-11 processor chip. Opening T9 unlocks the oscillator and allows tuning of the transmitter with the main dial while the rig is transmitting. For repeater operation, the switch must be closed, otherwise, the 600-kHz offset will not function. The physical location of the switch doesn't seem to be critical.

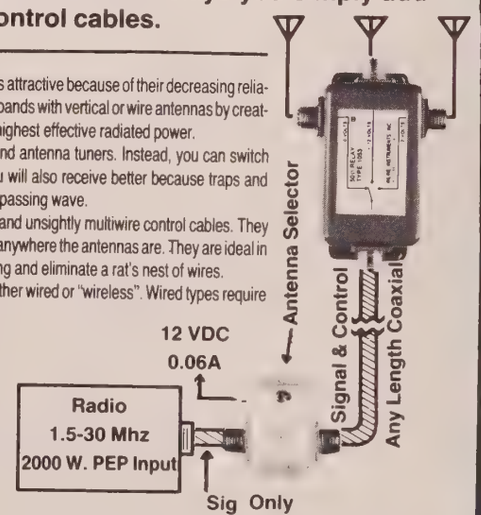
One small but interesting item, of the hints and kinks category, appeared in several publications. It describes a method of reducing the output of multimode transmitters that lack power-level control but feature an external ALC input. Although, a variety of schemes were presented, all of them work on essentially the same principle; an adjustable negative DC voltage is applied to the external ALC input to vary the gain of the i-f amplifier which, in turn, controls the output of the transmitter. Because the controlling range of the bias depends on the design of the rig, it is up to the user to determine the requirements experimentally. Availability of power-output control allows avoiding "overpowering" of the transponder on the satellite during favorable propagation conditions. It also dispenses with passive attenuators when a high gain power amplifies or a transverter is to be driven from an average 10-20W 2-m transceiver.

Imagine a fairly efficient antenna for indoor use, featuring azimuth and elevation contorls that can be erected, or dismantled, in less than a minute. The hardware consists of a door, a coat hanger, a few feet of string, and a small Yagi beam. Here, how it is done.

Hang the coat hanger on top of the door. Attach the string to the ends of the boom of the beam and suspend it from the coat hanger. Now, the azimuth can be "controlled" by swinging the door, and the elevation by repositioning of the angle of the suspended antenna. Although, not quite as efficient as a 20-element beam on the roof or a tower, it surely outperforms a "rubber duck" and even many outdoor verticals. Andy, KA2M (then WA2HGS) invented the "system" and used it with very encouraging results during vhf contests while living in a college dormitory. Garden gates, barn doors, and other nonmetalic swinging objects can serve as rotators for "field" operation. Apartment dwellers should give the system a try before giving up satellite communication altogether.

SWITCH 2 OR 3 OR 6 OR 9 ANTENNAS OVER ONLY ONE COAXIAL FEEDLINE
With INLINE "wireless" weatherproof coaxial relays you simply add more antennas without costly control cables.

For years to come sun spot activity will make 10, 15 and 20 meters less attractive because of their decreasing reliability. You can enjoy long distance and reliable operation on the lower bands with vertical or wire antennas by creating simple 2 element arrays. Remember—efficient antennas create highest effective radiated power.
Avoid wasting RF power and radiating efficiency using band traps and antenna tuners. Instead, you can switch antennas and get up to 10db more signal into that distant point. You will also receive better because traps and antenna tuners do not provide an effective signal gathering area to a passing wave.
INLINE relays can be installed virtually anywhere without expensive and unsightly multiwire control cables. They can be placed in the attic, on the roof, on a mast, on a tree, on a tower, anywhere the antennas are. They are ideal in apartment houses to overcome restrictions. They minimize hole drilling and eliminate a rat's nest of wires.
INLINE relays are available in two position and three position types, either wired or "wireless". Wired types require 1 conductor + ground.



Two position relays
Type 101A - DC to 180 MHz - $32.95 - Wired
Type 107* - DC to 970 MHz - $48.95 - Wired
Type 105 - 1.5 to 180 MHz - $54.95 - Wireless
Type 108* - 25 to 970 MHz - $74.95 - Wireless

Three position relays
Type 1013 - DC to 180 MHz - $49.95 - Wired
Type 1053/105C - 1.5 to 180 MHz - $79.95 - Wireless

Type 1053/105C Illustrated

Other types, all frequencies available. Relay power ratings decrease with increasing frequency. See literature for detailed chart
Distributed worldwide. Literature and application data upon request. If not in stock at your dealer order direct.
Add $2.00 for surface UPS. $3.50 for UPS Blue or Parcel Post. Overseas shipping at our cost. VISA, MASTERCHARGE accepted
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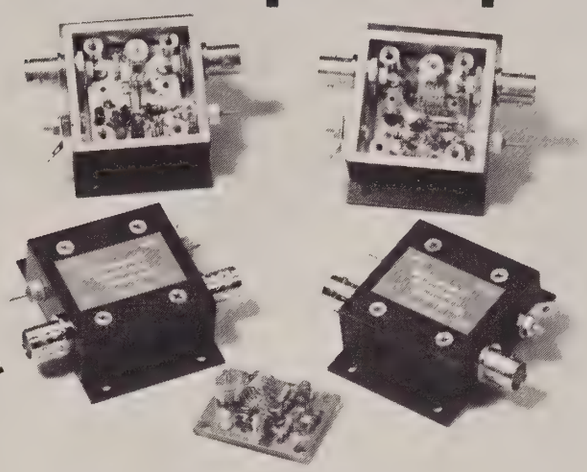

NEW GaAsFETs!

	Freq. Range (MHz)	N.F. (dB)	Gain (dB)	1 dB Comp. (dBm)	Device Type	Price
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P50VD	50-54	‹1.3	15	0	DGFET	$29.95
P50VDG	50-54	‹0.5	24	+12	GaAsFET	$79.95
P144VD	144-148	‹1.5	15	0	DGFET	$29.95
P144VDA	144-148	‹1.0	15	0	DGFET	$37.95
P144VDG	144-148	‹0.5	24	+12	GaAsFET	$79.95
P220VD	220-225	‹1.8	15	0	DGFET	$29.95
P220VDA	220-225	‹1.2	15	0	DGFET	$37.95
P220VDG	220-225	‹0.5	20	+12	GaAsFET	$79.95
P432VD	420-450	‹1.8	15	−20	Bipolar	$32.95
P432VDA	420-450	‹1.1	17	−20	Bipolar	$49.95
P432VDG	420-450	‹0.5	16	+12	GaAsFET	$79.95

Advanced Receiver Research

Preamps are available without case and connectors: subtract $10. Other preamps available in the 1 - 800 MHz range. Prices shown are postpaid for U.S. and Canada. CT residents add 7-½% sales tax. C.O.D. orders add $2. Air mail to foreign countries add 10%.

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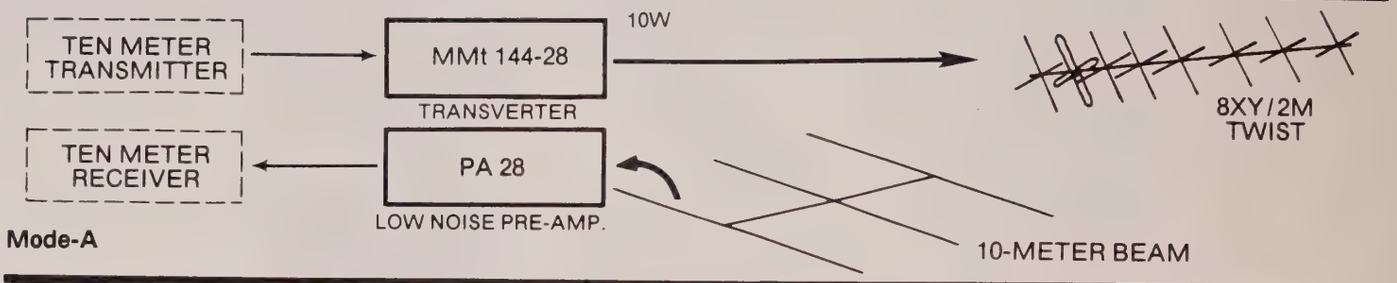
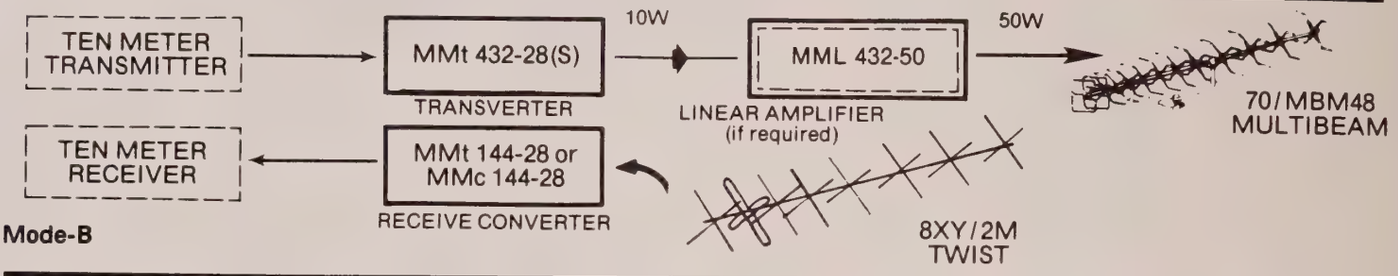
A prime example is our 420 - 450 MHz 18 element Circular Polarized antenna. Designed for optimized communications through OSCAR 9, the **420-450-18C** puts the lid on flutter and multi-path fading. And, with it's typical *KLM* broadband response, the 18C also meets the critical needs of DX'ers, ATV'ers, and the 440-450 FM group. Totally new engineering and construction techniques put the *KLM* **420-450-18C** head and shoulders above any competition. The optional CS-2 circularity switcher delivers fingertip control of circularity (RHC-LHC) right to your shack!

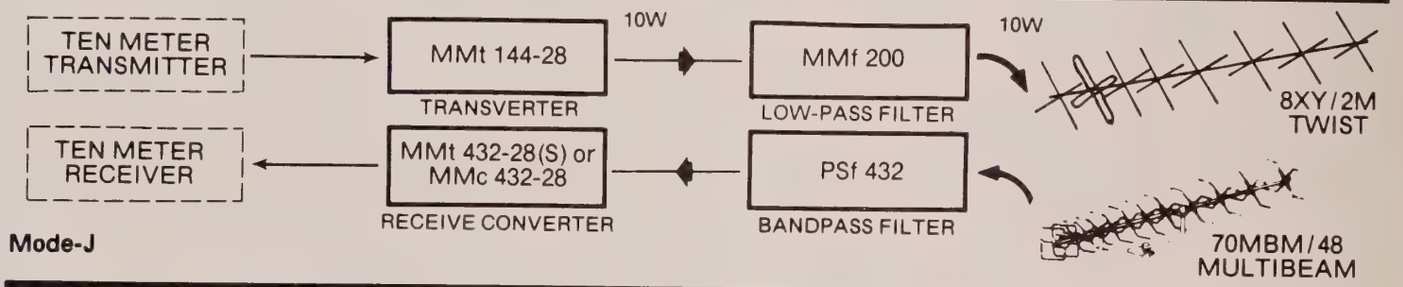
We didn't stop with the 18C. There's our Echo 70 transceiver, PA15-110CL linear power amplifier, 144-150-16C circular antenna and switcher, elevation and azimuth rotators, preamps and converters, "Great Little Towers," and more. **YOUR SATELLITE STATION IS AS CLOSE AS YOUR *KLM* DEALER.** Give him a call. For complete information contact:

KLM P. O. Box 816, Morgan Hill, CA 95037

OSCAR SYSTEMS FROM SPECTRUM INTERNATIONAL







CONVERTERS AND TRANSVERTERS FOR

OSCAR 7
OSCAR 8
PHASE III

Specifications:
Output Power: 10W.
Receiver N.F.: 3 dB typ.
Receiver Gain: 30 dB typ.
Prime Power: 12 Vdc

Receive Converters
MMc 144 $59.95
MMc 432-28(s) $81.50
MMc 432-28(TC) $79.95

UHF Filters:
MMf 200-5 $31.95
MMf 200-7 $42.95
PSf 432 $59.95

Receive Preamplifier:
PA-28 $35.95

Mod. kit to adapt original MMt 432-28 FOR Mode-J operation: $26.50

Transverters by Microwave Modules and other manufacturers can convert your existing low-band rig to operate on the VHF and UHF bands. Models also available for 2M to 70 Cm and for ATV operators from Ch2/Ch3 to 70 Cm. Each transverter contains both a Tx up-converter and an Rx down-converter. Write for details of the largest selection available.

Attention owners of the original MMt 432-28 models: Update your transverter to operate OSCAR 8 and Phase III by adding the 434 to 436 MHz range. Mod. kit including full instructions is $26.50 plus $1.50 shipping.

ANTENNAS

2-Meter 8 + 8 Twist Model 8XY/2M	$57.75
Phasing Harness Model PMH/2C	$12.35
48 el. 70 Cm Multibeam Model 70-MBM-48	$75.75
88 el. 70 Cm Multibeam Model 70-MBM-88	

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Send 36 cents (two stamps) for full details of KVG crystal filters and other products to fill all of your VHF/UHF equipment needs.

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Lunar's transverter modules put you here!

Adding various combinations of Lunar's transverter modules to your present station greatly expands your capabilities to: work an Oscar including Phase III; receive noise from the sun for solar flare investigation or for plotting galactic noise sources; receive weather satellite transmission ; or practically anything else found on HF through UHF.

Our transverter modules are distinctly different from the usual transverter or the home built transverter module. With the single band transverter you must purchase a different unit for each additional band you wish to cover.

Lunar's transverter modules, on the other hand, start with the basic down converter for receive and up converter for transmit. Selecting an appropriate local oscillator module determines the band. Additional modules are added to achieve desired receiving NF and/or output power. Changing the local oscillator module changes the band. Pre amps you already have or might build may be used as desired, similarly, for the transmit side.

It's easier than building your own modules from scratch, and costs much less than buying a complete transverter for each additional band.

Some examples of expected performance using Lunar modules.

EXAMPLE 1

Selected modules:
DC 28
LO 28/144
UC-VHF
PAD 144
PAM 144

This combination gives you:
RF: 144 to 146MHz
IF: 28MHz to 30MHz
Conversion Gain: 25dB
Overall NF: 2 dB nom. 1.6 dB typical
Image Rejection: –30 dB typical
LO Purity: –50 dB max. all spurs & harmonics
Drive 28MHz: 1 to 5 mW
Power Output: 20 watts min.
Operating Voltage: 24VDC @ 2.5 amps. nom.

EXAMPLE 2

Modules added to Ex. 1
LO 28/220/222
PAM 220
PAD 220

This gives you:
RF: 220-222, 222-224MHz
Conversion Gain: 22 dB
Overall NF: 2.5 dB typ., 2.2 nom.
Other specs. remain the same.

If you have a specific band you'd like to cover, write or call us and we'll be happy to discuss it with you. Or send for our literature on transverter modules.

LUNAR electronics®

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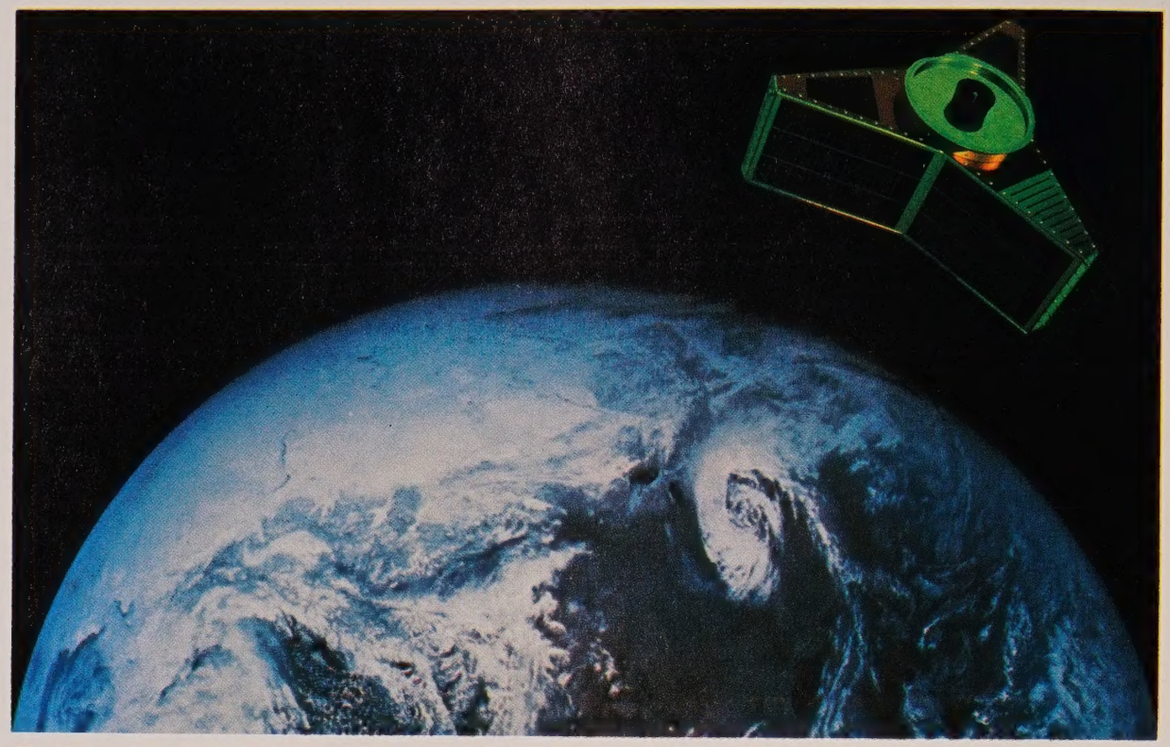

The Official AMSAT QSL Card:

There are just two ways to make a QSL card stand out: (1 You can make it gaudy, or, (2 You can make it simple but elegant. We've chosen simple elegance! If ever a picture spoke volumes, this QSL intones very special things about its owner. Most of all, it says its sender is a solid AMSAT supporter. It connotes the stark adventure we know as part of the "Hams In Space" theme.

We've combed the archives for photo images that would convey just that feeling because we know you want to share that spirit with others through your QSL.

As you see, the face of the QSL is clean, pure and simple. At once you get the notion of space adventure. And, your callsign appears unobtrusively in this important context.

We strongly believe the distinctive nature of this QSL is in keeping with the distinguished interests of our ardent supporters. Send today! For a copy of AMSAT's Official Order Form, please write to AMSAT QSL, P.O. Box 27, Washington, DC 20054.

AMSAT T-Shirts!

It's nearly spring and time to shed those winter coats. Just picture yourself in one of the new AMSAT "Ham's-in-Space" T-shirts!

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Yaesu's All-New VHF/UHF Transceivers!

Yaesu is proud to introduce a new generation of computerized VHF and UHF equipment. With the features you have asked for and the quality you demand, these revolutionary transceivers are your passport to the newest frontiers in Amateur Radio!

COMPLETE OSCAR STATION!

- **FT-480R - 143.5 to 148.5 MHz SSB/CW/FM**
- **FT-780R - 430-440 MHz SSB/CW/FM**
- **SC-1 Station Console w/Digital Clock**

A complete microprocessor-based communication system with convenient switching of scanning and microphone controls, AC power supply, and 16 button tone pad.

FT-290R 2M MULTIMODE PORTABLE!

- **Battery Powered (NiCd C-Cells Optional)**
- **LCD Display with Night Light**
- **USB/LSB/CW/FM with 2.5W RF Output**

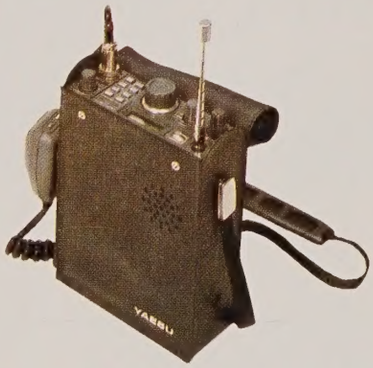
An entirely new concept in VHF operating! LCD display with full microprocessor control, 10 memories, two VFO's and multimode flexibility, all from a battery powered package. Telescoping antenna built in. Optional FL-2010 PA and FP-80A AC Supply.

FT-208R

2 METER FM HAND-HELD!

- **LCD Display with Lithium Backup Cell**
- **Selectable 5 kHz/10 kHz Scanning**
- **10 Memories with Auto/Resume Scan**
- **16 Button Tone Encoder**

Yaesu's latest thoroughbred for 2 FM is the FT-208R Hand-Held. Four digit LCD display, 10 memories, limited band scan, and priority channel make this the most versatile hand-held ever made available to the amateur fraternity.



FT-690R

6M MULTIMODE PORTABLE!

- **USB/CW/AM/FM Battery Portable**
- **LCD Frequency Display with Night Light**
- **10 Memories with Lithium Backup Cell**

Catch those exciting DX openings with the new FT-690R 6 meter portable. Repeater shift (1 MHz), two scanning steps per mode, and dual VFO's for top flexibility.

FT-708R

70 CM FM HAND-HELD!

- **LCD Display with Lithium Backup Cell**
- **Selectable 25 kHz/50 kHz Scanning Steps**
- **440-450 MHz with 10 Memories**
- **Memory/Band Scan and Limited Band Scan**
- **Resume Scan**
- **16 Button Tone Encoder**

Yaesu leads the way with its pioneering microprocessor controlled 440 MHz hand-held. Priced competitively against much simpler units, the FT-708R system includes a full line of accessories, including CTCSS, NiCd chargers, and remote speaker/microphone options.

Sporting unmatched engineering and manufacturing know-how, Yaesu's technical staff is committed to pushing the state of the art. Yaesu products are backed by a nationwide dealer network and two factory service centers for your long-term service needs. So when it's time to upgrade your station equipment, join the thousands of hams that are tired of compromise – join them by investing in Yaesu!

Some accessories pictured above are extra-cost options. See your Yaesu dealer.

Price And Specifications Subject To Change Without Notice Or Obligation

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Watt's new...on 2 meters?

All mode (FM/SSB/CW) 25 watts, plus...!!!

TR-9130

The TR-9130 is a powerful, yet compact, 25 watt FM/USB/LSB/CW transceiver providing increased versatility of operation on the two meter band. It features six memories, memory scan, memory back-up capability, automatic band scan, all-mode squelch, CW semi break-in, and incorporates microprocessor technology. It is available with a 16-key autopatch UP/DOWN microphone (MC-46), or a basic UP/DOWN microphone.

TR-9130 FEATURES:

- **25 Watts RF output**
  All modes, (FM/SSB/CW), utilize a new high power linear module, for more reliable FM operation and increased DX on SSB or CW.
- **FM/USB/LSB/CW all mode operation**
  For added convenience in all modes of operation, the mode switch, in combination with the digital step (DS) switch, determines the size (100 Hz, 1 kHz, 5 kHz, 10 kHz) of the tuning step, and the number of digits displayed.
- **Six memories**
  On FM, memories 1 through 5 for simplex or ±600 kHz offset, with the OFFSET switch. Memory 6 for non-standard offset. All six memories may be operated simplex, any mode.
- **Memory scan**
  Scans memories in which data is stored. Stops on busy channels.
- **Internal battery memory back-up**
  With 9 volt Ni-Cd battery installed, (not KENWOOD supplied), memories will be retained approximately 24 hours, adequate for the typical move from base to mobile. A terminal is provided on the rear panel for connecting an external back-up supply.
- **Automatic band scan**
  Scans within whole 1 MHz segments (ie., 144.0-144.999 MHz), for improved scanning efficiency.
- **Dual digital VFO's**
  Incorporates two built-in digital VFO's, selected through use of the A/B switch, and individually tuned.
- **Transmit frequency tuning for OSCAR operations**
  On SSB or CW, the tuning knob or UP/DOWN buttons on the microphone may be used to adjust the transmit frequency during transmission.
- **16-key autopatch UP/DOWN microphone version**
  The TR-9130 is available with the MC-46 16-key autopatch UP/DOWN microphone, or with the basic UP/DOWN microphone. Manual UP/DOWN scan of entire band possible using either microphone.
- **Squelch circuit on all modes (FM/SSB/CW)**
  The squelch circuit is effective on SSB, CW, and FM.
- **Repeater reverse switch**
  For checking signals on the repeater input, on FM.
- **Tone switch**
  For activating a tone device, (not KENWOOD supplied).
- **CW semi break-in circuit with sidetone**
  Built-in, for convenience in CW operations.
- **Digital display with green LED's**
- **High performance receive-transmit design**
  The use of a low-noise dual-gate MOSFET plus two monolithic crystal filters in the receiver front-end results in excellent two signal characteristics. Care in transmitter design assures clean signals in all modes.
- **Compact size and light weight**
  170 (6-11/16) W x 68 (2-11/16) H x 241 (9-1/2) D mm (inch), 2.4 kg (5.3 lbs.) weight.
- **Extended frequency range**
  Covers 143.9 to 148.9999 MHz, which includes certain MARS and CAP frequencies.
- **Transmit offset switch**
- **High performance noise blanker**
  Suppresses pulse-type noise on SSB and CW.
- **RF gain control**
  For all modes of operation.
- **RIT (Receiver Incremental Tuning) circuit**
  Useful during SSB/CW operations.
- **Amplified AGC**
  Enhances SSB and CW operation. The AGC time constant is automatically optimized for each mode of operation.
- **HI/LOW power switch**
  Selects 25 or 5 watts RF output on FM or CW.
- **Accessory terminal**
  A four pin accessory terminal is provided for use with a linear amplifier or other accessory.
- **Quick release mounting bracket** (Supplied)

More information on the TR-9130 is available from all authorized dealers of Trio-Kenwood Communications 1111 West Walnut Street, Compton, California 90220.

KENWOOD
...pacesetter in amateur radio

Accessories:

- KPS-7 Fixed station power supply.
- TK-1 AC adapter for memory back-up.

Subject to FCC Approval.
Specifications and prices are subject to change without notice or obligation.